City of Seattle

LOWER DUWAMISH WATERWAY SLIP 4 EARLY ACTION AREA

LONG-TERM MONITORING DATA REPORT YEAR 1 (2013)

Submitted to
U.S. Environmental Protection Agency
1200 Sixth Avenue
Seattle, WA 98101

Submitted by
City of Seattle

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ACRONYMS AND ABBREVIATIONS

BEHP	bis(2-ethylhexyl) phthalate
Boeing	The Boeing Company
CFR	Code of Federal Regulations
City	City of Seattle
COC	chain-of-custody
CSL	cleanup screening level
DSOA	Duwamish Sediment Other Area
EAA	early action area
Ecology	Washington State Department of Ecology
EE/CA	engineering evaluation and cost analysis
EPA	U.S. Environmental Protection Agency
GTSP	Georgetown Steam Plant
ICIR	institutional controls implementation report
Integral	Integral Consulting Inc.
LDW	Lower Duwamish Waterway
LTMRP	long-term monitoring and reporting plan
LTST	long-term stormwater treatment
MLLW	mean lower low water
NBF	North Boeing Field
NTU	nephelometric turbidity unit
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
QAPP	quality assurance project plan
QC	quality control
RACR	removal action completion report
RAO	removal action objective
RCRA	Resource Conservation and Recovery Act
RI/FS	remedial investigation/feasibility study

RNA	regulated navigation area
RPD	relative percent difference
SQS	sediment quality standards
SVOC	semivolatile organic compound
TOC	total organic carbon
USCG	U.S. Coast Guard

REPORT CERTIFICATION

The following certification is provided pursuant to the Administrative Settlement Agreement and Order on Consent for Removal Action, Appendix A, Statement of Work, Task 5 – Long-Term Monitoring and Reporting Plan.

CITY OF SEATTLE – PROJECT MANAGER CERTIFICATION

I, Allison Crowley, City of Seattle Project Manager for the long-term monitoring work conducted at the Slip 4 Early Action Area, Lower Duwamish Waterway Superfund Site, hereby provide the following certification:

Under penalty of perjury under the laws of the United States, I certify that to the best of my knowledge, after appropriate inquiries of all relevant persons involved in the preparation of this report, the information submitted is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment.

Allison Crowley 1-28-2014

Allison Crowley
Project Manager
City of Seattle

Date

1 INTRODUCTION

This data report describes the activities and results associated with the Year 1 (2013) monitoring of the long-term effectiveness of the Slip 4 Early Action Area (EAA) cleanup within the Lower Duwamish Waterway (LDW) Superfund site in Seattle, Washington (Figure 1-1). All Year 1 monitoring activities were carried out by Integral Consulting Inc. (Integral) in accordance with the Long-Term Monitoring and Reporting Plan (LTMRP; Integral 2013a), which was prepared in accordance with the requirements set forth in the Slip 4 EAA Administrative Settlement Agreement and Order on Consent and associated Scope of Work and Action Memorandum (USEPA 2006).

Slip 4 is a 6.4-acre navigational slip located 3 miles upstream from the confluence with Elliott Bay and Puget Sound. It is one of five priority early action sites identified within the 5.5-mile long LDW Superfund site. The EAA contains 3.58 acres within the slip in which sediments were contaminated with polychlorinated biphenyls (PCBs), metals, organic compounds, and petroleum products.

1.1 SEDIMENT CLEANUP ACTION

The City of Seattle (City) completed a non-time-critical removal action to address contaminated sediment at the Slip 4 EAA on February 7, 2012 (Integral 2012). The primary objective of the Slip 4 removal action was to reduce the concentrations of PCBs and other chemicals in the post-cleanup surface sediments to below the Washington State Sediment Quality Standards (SQS). The primary design and construction elements included:

- Dredging and excavation of approximately 10,256 cubic yards of contaminated bottom sediment and bank soil
- Transloading and disposal of 17,334 tons of soil, sediment, and debris in a Subtitle D landfill, including approximately 130 tons of creosote-treated timbers and piles
- Demolition of 20,019 square feet of concrete pier structure
- Recycling of 3,278 tons of concrete and 79 tons of steel
- Construction of stable slopes, sediment caps, and slope caps over 3.43 acres using 53,006 tons of clean material
- Construction of engineered soil covers and expanded habitat in former upland areas.

The construction of sediment and slope caps following the removal of contaminated sediment and soil, in conjunction with the engineered soil covers and habitat enhancements, resulted in clean material placement over all remaining contaminated soils and sediments within the Slip 4 EAA, as shown on Figures 1-2 and 1-3. Overall the cleanup resulted in a net gain of over an acre of shallow and riparian habitat for threatened Puget Sound Chinook and Coastal/Puget Sound bull trout.

The 2012 post-construction surface sediment confirmation sampling results from the slope and waterway cap areas verified that surface sediment characteristics within the Slip 4 EAA met the removal action objective (RAO) after construction (Integral 2012). However, post-construction sampling outside of the Slip 4 EAA (within the boundary area) revealed that surface sediment PCB concentrations had increased within the boundary area during the course of construction activity. The U.S. Environmental Protection Agency (EPA)-approved response was the placement of a 9-in. nominal lift of waterway cap material (referred to as "boundary area material") over the boundary area sediments. Subsequent sampling was performed to document surface conditions following boundary area material placement. The results indicated that, after placement of the boundary area material, PCB concentrations within the surface sediment met the RAOs. Details of the construction activities are summarized in the Removal Action Completion Report (RACR; Integral 2012), approved by EPA in July 2012.

The 2012 post-boundary area material placement sampling results and 2012 Slip 4 EAA post-construction confirmation sampling results represent the baseline conditions for the Slip 4 EAA long-term monitoring program, which is designed to identify potential concerns with the long-term performance of the remedy in the Slip 4 EAA. Hereafter, any reference to 2012 post-boundary area material placement and post-construction confirmation sampling data will be referred to as "baseline" in this report.

1.2 SOURCE CONTROL ACTIONS

Potential sources of chemicals to Slip 4 were evaluated in the Slip 4 engineering evaluation and cost analysis (EE/CA; Integral 2006), including bank erosion and outfalls. The EE/CA addressed bank erosion by including actions to stabilize and contain the banks as part of the Slip 4 remedy. Stormwater-related source control activities conducted by the City, King County, Washington State Department of Ecology (Ecology), and The Boeing Company (Boeing) were also mentioned in the EE/CA, including business inspections within the Slip 4 drainage basin; source tracing and source identification using catch basin, in-line sediment trap, and caulk samples; and an investigation of the Georgetown Flume. Potentially significant ongoing sources of PCBs and phthalates to Slip 4 were identified in upland drainage systems discharging to Slip 4.

A number of actions were undertaken following the EE/CA and prior to the Slip 4 EAA cleanup to reduce the potential for stormwater to result in recontamination of the Slip 4 sediment surface. Actions included the following:

1. The Georgetown Steam Plant (GTSP) flume was removed in 2009 and replaced with a 12-inch closed pipe. A small area of the property, primarily consisting of the main building roof, drains to this new pipe that discharges to Slip 4. Numerous side

connections to the flume were disconnected during installation of the new storm drain pipe. As part of the flume removal, sediments from within the flume and PCB-contaminated soils immediately surrounding the flume were removed and disposed offsite.

2. Soil containing elevated concentrations of PCBs was excavated from the North Boeing Field (NBF) and GTSP properties. Soil with elevated concentrations of total petroleum hydrocarbons was also removed from the GTSP property. These soils and groundwater, which had the potential to infiltrate the NBF stormwater system and discharge to Slip 4, were disposed offsite. Site restoration activities completed at GTSP following these removal actions have minimized offsite runoff from GTSP, with the majority of site stormwater now managed through onsite infiltration (Integral 2011).
3. The majority of stormwater generated on NBF is treated via a long-term stormwater treatment (LTST) system (built by Boeing in 2011) prior to discharge to Slip 4. The design of the LTST is such that very small particles may pass through the LTST and be discharged to Slip 4, although particles of this size are not expected to settle in Slip 4 (Landau 2013). The first year the LTST operated (November 2011–November 2012), approximately 68 percent of the stormwater was treated, with larger volumes bypassing the treatment system during storm events (Landau 2013). PCBs and other hazardous substances in the stormwater continue to be monitored prior to discharge. In the first year of monitoring, all samples collected at the point of compliance were below the marine chronic water quality criterion interim goal of 0.030 µg/L for PCBs. Semi-volatile organic compounds (SVOCs), including polycyclic aromatic hydrocarbons (PAHs) and bis(2-ethylhexyl)phthalate (BEHP), were also monitored. Generally, concentrations of all monitored parameters, including total suspended solids, increased during storm events; however, all concentrations remained below marine chronic water quality criteria except for one minor exceedance for dissolved copper (3.6 µg/L compared to the marine chronic criteria of 3.1 µg/L).

Ecology is currently working on a remedial investigation/feasibility study (RI/FS) at the NBF/GTSP Model Toxics Control Act site to address additional cleanup needs. A work plan was completed in 2013 and implementation of the remedial investigation work plan is scheduled for 2014. The NBF/GTSP RI/FS will determine if any additional cleanup actions in the area draining to Slip 4 are required.

1.3 MONITORING OBJECTIVES

Hazardous substances remain onsite in Slip 4 EAA sediments and soils at levels greater than those that allow for unrestricted use or unlimited exposure. These remaining hazardous substances are physically and chemically isolated beneath an engineered sediment cap and soil cap. Long-term monitoring is being performed to verify that the remedy at the Slip 4 EAA remains protective of human health and the environment.

The long-term success of the sediment removal action for the Slip 4 EAA will be verified by monitoring endpoints that directly relate to the RAO for the cleanup. The RAO for Slip 4 is to reduce the concentration of contaminants in post-cleanup surface sediments (biologically active zone [0–10 cm]) to below the Washington State SQS for PCB Aroclors and other chemicals of interest, thereby reducing risks to human health and the environment resulting from potential exposure to contaminants in the Slip 4 EAA sediments (USEPA 2006). The removal boundary for the early action was established to include sediments exceeding the SQS (USEPA 2006).

The SQS for total PCB Aroclors is 12 mg/kg OC (milligrams per kilogram, organic carbon-normalized) when the total organic carbon (TOC) content is between 0.5 and 4.0 percent. Similarly, the Washington State cleanup screening level (CSL) for total PCB Aroclors is 65 mg/kg OC. When TOC is less than 0.5 percent or greater than 4.0 percent, regulatory comparisons are made to the lowest apparent effect threshold concentration (130 μg/kg based on dry weight) and the CSL established for the LDW site-wide cleanup (1,300 μg/kg based on dry weight).

The Slip 4 removal action design included dredging and excavation to target elevations designed to remove the most highly contaminated sediments, create stable slopes, and improve and expand habitat. The removal action was not designed to remove all sediment exceeding the SQS. Accordingly, the design called for placement of engineered sediment and soil caps to physically and chemically isolate contaminants that may have been left behind. Cap material thickness varies from 24 to 33 in. for slope cap and soil cover areas, and from 30 to 60 in. for waterway cap areas. Sediment/soil removal areas and cap placement designs are shown in Figure 1-2.

Specific study questions to be answered by the monitoring program are:

- Are contaminant concentrations in Slip 4 EAA surface sediments (0–10 cm) below the SQS?
- Is the physical integrity of the cap in the Slip 4 EAA being maintained such that the sediment cap continues to isolate contaminants in underlying sediments from marine biota?
- Do the institutional controls associated with the Slip 4 EAA remedy remain in place and continue to work effectively?
- Are physical changes occurring related to sediment erosion and sediment deposition in the Slip 4 EAA?

In addition, sediment samples were collected from two boundary area locations in Year 1 to confirm that conditions outside of the Slip 4 EAA removal boundary have not changed substantively since baseline samples were collected in 2012. Informational inputs designed to address these specific study questions are provided in Table 1-1.

The long-term monitoring schedule is provided in Table 1-2. In accordance with the long-term monitoring schedule, Year 1 monitoring included the following:

- Storm flow monitoring – a summary of 100-year storm events from post construction through Year 1 monitoring (February 2012 through July 2013)
- Visual inspection
- Sediment sample collection from the slope cap, waterway cap, and boundary area for the target parameters listed in Table 1-3
- Institutional control updates
- Review of physical construction/investigations by others

Sediment and soil sampling locations for long-term monitoring in the Slip 4 EAA, shown on Figure 1-3, are the same locations that were sampled to determine baseline conditions.

1.4 SUMMARY OF FINDINGS

Year 1 monitoring results indicate that the sediment and slope caps throughout the Slip 4 EAA are performing as designed, and they continue to isolate underlying contaminated sediments. Fine sediment has accumulated on the sediment cap in most of the EAA except near the head of the slip, with accumulations ranging from 0 to 8 cm in the EAA and up to 10 cm between the EAA and the mouth of the slip. There were two minor SQS exceedances within the waterway cap area of the EAA. The total PCB concentration at location WC-3 was 12.3 mg/kg OC compared to the SQS of 12 mg/kg OC. The BEHP concentration at location WC-1 was 47.9 mg/kg OC compared to the SQS of 47 mg/kg OC. Based on observations from the visual survey, evaluation of potential sources of depositional sediments, and 2013 data (AMEC 2013) collected in Slip 4 and in the Lower Duwamish Waterway, the most likely source of fine sediments that deposited on the cap is resuspended sediments from beyond the Slip 4 EAA.

1.5 REPORT ORGANIZATION

The remainder of this report is organized as follows:

- Section 2 – Monitoring Activities
- Section 3 –Laboratory Analysis

- Section 4 – Data Management and Quality Assessment
- Section 5 – Results and Conclusions
- Section 6 – References

Figures and tables summarizing each monitoring element are presented at the end of the text.

Appendices provide supporting project documentation and are organized as follows:

- Appendix A – Rain-Gauge and Tide Data
- Appendix B – Visual Inspection Field Forms
- Appendix C – Visual Inspection Photographs (2012 and 2013)
- Appendix D – Surface Sediment Field Forms and Field Notebook
- Appendix E – Surface Sediment Photographs
- Appendix F – Laboratory Analytical Report
- Appendix G –Validation Report
- Appendix H – Other Sediment Investigations – 8th Avenue Terminals Sediment Sampling
- Appendix I – Other Sediment Investigations – Boeing Plant 2 2012-2013 Construction Season Completion Report

2 MONITORING ACTIVITIES

2.1 STORM FLOW MONITORING

Erosion of the Slip 4 EAA cap is not expected as a result of peak river flows or stormwater discharge into the slip. The water level of the Duwamish River is controlled by the Howard A. Hanson Dam, and thus does not flood during high flow events. Further, Slip 4 is an off-channel feature of the Duwamish Waterway, and currents within the EAA are not expected to be significantly affected by changes in river flow. In addition, the cap and associated armoring was conservatively sized to accommodate unimpeded flow from outfalls within the slip from a 100-year storm event during an extreme low tide.

As a means of verifying and documenting the performance of the cap under storm conditions, the City, in accordance with the LTMRP, is required to summarize storm events equal to or greater than a 100-year storm event that occur within 48 hours prior to low-tide conditions during the monitoring reporting period. For the project site area, the 100-year storm event corresponds to 3.85 in. of rainfall within a 24-hour period, as measured from the Seattle Public Utility rain-gauge (Station 45-S016, Metro King County, E. Marginal Way). If rainfall meeting a 100-year storm event were to occur during the monitoring reporting period, tidal elevations below 5.2 ft mean lower low water (MLLW), corresponding to the invert elevation of the largest outfall within Slip 4 (the 72-in. diameter Interstate 5 outfall; Figure 1-3), would be documented and summarized for the 48-hour period following the storm event to evaluate whether storm-related outfall discharge may have impacted the cap during heavy rainfall events followed by low tide conditions.

Rain gauge data for Station 45-S016 was obtained from Seattle Public Utilities (Peck 2013, pers. comm.). Tide data was downloaded directly from the National Oceanic and Atmospheric Administration's Tides and Currents website (NOAA 2013). Rain gauge and tide data for the Year 1 monitoring period are provided in Appendix A. No 100-year storm events occurred within the Slip 4 EAA Year 1 monitoring period from February 7, 2012, to July 22, 2013.

2.2 VISUAL INSPECTION

The purpose of the visual inspection is to document the general condition of the cap, identify any obvious changes in bathymetry/topography resulting from erosion or sedimentation processes, identify any visible breaches of the cap integrity, and note the condition of the constructed habitat features (e.g., integrity of anchored woody debris).

2.2.1 Site Inspection

The visual inspection for the Year 1 monitoring was conducted in accordance with the quality assurance project plan (QAPP; LTMRP, Appendix A, Integral 2013a), and included still color photographs of the Slip 4 EAA sediments exposed during the extreme low tide on July 22, 2013. Photographs were taken from vantage points consistent with those used to document post-capping conditions using a 10 megapixel digital camera with a 3.6x optical zoom lens with a focal length of 6.7 to 24.0 mm. The locations of the photo stations are shown on Figure 2-1. Coordinates for the photo stations are listed in Table 2-1. Station locations were permanently marked with rebar and waterproof spray paint to allow for exact vantage point positioning during future monitoring events. Visual inspection forms were used to document conditions of the areas represented by the photographs and are provided in Appendix B, along with the site map used during monitoring. Year 1 visual inspection photographs were compared with photographs taken from similar vantage points documenting 2012 post-capping conditions following completion of the EAA remedy, and are presented together in Appendix C. Additional photographs were taken of the upland north and south pocket beaches for comparison with future monitoring events, and are presented in Appendix C.

Year 1 cap observations are summarized in Table 2-2 and are discussed in Section 5.

2.2.2 Field Deviations

As noted in Table 2-2 and Figure 2-1, three photo stations were relocated in the field. Stations A and J were identified in the LTMRP as being in what was likely a subtidal area of the slip. Therefore during this first monitoring event, these stations were relocated to the northwest, close to the 8th Avenue Terminals property bulkhead, to allow for upland access. Station I was relocated to the west, from the First South Property upland area to within the Slip 4 EAA boundary.

2.3 SEDIMENT SAMPLING

The purpose of the sediment sampling is to document surface sediment (0–10 cm) conditions within the Slip 4 EAA. Year 1 sediment sampling included collection of surface sediments from two slope cap and six waterway cap locations within the Slip 4 EAA. Surface sediments were also collected from two boundary area locations located just outside the Slip 4 EAA. Descriptions of the samples collected and analyses performed are presented below.

The physical characteristics of each sediment sample were documented in sediment sample log sheets. Any vegetation or debris on the surface of the sediment/soil was removed prior to sampling and noted on the field log sheets. In addition, the presence of aquatic organisms and/or terrestrial wildlife, if observed, was noted on the sample log sheet or in the field notebook. Field log sheets and copies of pages from the field notebook are provided in

Appendix D. Photographs were taken of each sediment sample and are provided in Appendix E.

2.3.1 Sample Collection

All sediment samples were collected in accordance with the QAPP (LTMRP, Appendix A, Integral 2013a) except as noted in the following sections. The station target locations correspond to the locations sampled for baseline cap verification as described in the RACR (Integral 2012). Surface sediment sampling was conducted by hand or by boat as indicated below. Sediment sampling locations below the waterline were accessed by the sampling vessel, *R/V Tahoma*, operated under the direction of Steve Saugen, co-owner of Gravity Environmental LLC. The *R/V Tahoma* is an aluminum, flat deck, 32-foot-long, catamaran vessel with twin 315-horsepower diesel engines, equipped with a hydraulically operated A-frame and variable speed winch. The vessel is also equipped with a differential global positioning system and a depth sounder.

Sample stations are shown on Figure 1-3. Sample coordinates are presented in Table 2-3. Sample collection field notes for both January 2012 confirmation sampling and July 2013 long-term monitoring are summarized in Table 2-4.

2.3.1.1 Slope Cap Samples

A three-point composite of surface sediment (0–10 cm) was collected on July 22, 2013, from two bank (slope cap) sampling stations designated SC-2 and SC-3, as shown on Figure 1-3. Bank sediment sample locations were accessed on foot, and sediments were collected by hand at low tide using a stainless steel trowel, spoon, and bowl as described in the QAPP.

The QAPP specified that the three-point composite samples for each location were to be collected at approximately +2, +8, and +12 ft MLLW. During post-construction confirmation sampling it was noted that sediment from the +2 ft MLLW elevation was located within the waterway cap area and did not represent slope cap material. As noted in the RACR the sediment location at +2 MLLW elevation was revised to +4 MLLW during post-construction confirmation sampling. As this deviation was corrected prior to the collection of the post-construction confirmation sampling it does not impact the quality of the data. Slope cap material for the three-point composite was therefore collected from approximately +4, +8, and +12 ft MLLW.

2.3.1.2 Waterway Cap Samples

Six discrete waterway cap surface sediment (0–10 cm) samples (WC-1 through WC-4, WC-7, and WC-8) were collected on July 22 and 23, 2013, at the locations shown on Figure 1-3. Locations WC-1, WC-2, and WC-4 were accessed on foot, and sediments were collected by hand at low tide using a stainless steel trowel, spoon, and bowl as described in the QAPP. Locations WC-3, WC-7, and WC-8 were accessed by sampling vessel using a hydraulic power grab sampler in accordance with procedures referenced in the QAPP.

2.3.1.3 Boundary Area Samples

Two discrete boundary area surface sediment (0–10 cm) samples (BD-2 and BD-7) were collected on July 23, 2013, at the locations shown on Figure 1-3. Boundary-area locations were accessed by sampling vessel using a hydraulic power grab sampler for the collection of surface sediments in accordance with procedures referenced in the QAPP.

2.3.2 Sample Processing

Sample processing occurred in the field and followed procedures presented in the QAPP (LTMRP, Appendix A; Integral 2013a). At each of the sampling locations, the top 10 cm of sediment were collected. Any vegetation, debris, or rocks collected greater than 0.5-in. in size were removed prior to sampling and noted in the field log book.

For each slope cap sample, approximately equal volumes of sediment were collected from each of the three elevations (+4, +8, and +12 ft MLLW) and were composited into a single sediment sample for that location. For waterway cap and boundary area samples, discrete sediment samples were collected from each location.

Each sediment sample was placed into a decontaminated, stainless-steel mixing bowl and thoroughly homogenized using a stainless-steel spoon until the sediment attained a visually uniform color and texture. Aliquots of the homogenized sediment were then placed into labeled, certified clean laboratory sample containers with Teflon-lined lids, and were placed on ice in coolers.

2.3.2.1 Field Equipment Decontamination

All sampling equipment that came into contact with the samples (e.g., grab sampler; and stainless-steel bowls, spoons, trowels, and ruler) were decontaminated prior to use and between each sample. All field equipment decontamination followed the procedures outlined in the QAPP and was consistent with the procedures as outlined in standard operating procedure SD-01 (LTMRP, Appendix A, Attachment A3; Integral 2013a).

2.3.2.2 Field Quality Control Samples

Field quality control (QC) samples were used to assess sediment sample variability, evaluate potential sources of contamination, and to determine if samples were maintained at the proper temperature during shipping. All field QC samples were collected at the appropriate frequency and in accordance with the procedures referenced in the QAPP (LTMRP, Appendix A; Integral

2013a). The following field QC samples were collected in the field and analyzed by the analytical laboratory:

- One split sample was collected in the field at station WC-2 and analyzed for PCBs, semivolatile organic compounds (SVOCs), and metals to assess the variability associated with field sample processing and laboratory analysis. The split sample was assigned a unique number and was not identified as a field split to the laboratory. The parent sample and split sample results are discussed in Section 4.
- One equipment filter wipe sample was collected to help identify possible contamination from the sampling environment or from the sampling equipment (e.g., stainless-steel trowel, bowls, and spoons). The filter wipe sample was analyzed for PCBs, select SVOCs, and metals. The equipment filter wipe sample was clearly noted in the field logbook (e.g., sample identifier, equipment type, date and time of collection, analysis and filter lot number). Filter wipe sample results are discussed in Section 4.
- One filter blank was collected for each lot number of filter wipes used to evaluate potential background concentrations in the equipment filter wipe sample. The filter blank sample was archived at the analytical laboratory pending results from the equipment filter wipe sample. If the equipment filter wipe sample results indicate a potential issue with cross-contamination (i.e., detected chemical concentrations at levels that may impact sediment samples), then the filter blank would be analyzed to separate out potential filter wipe background concentrations from potential cross contamination from the equipment used.

Temperature blanks were used by the laboratory to verify the temperature of the samples upon receipt at the testing laboratory. The blanks were transported unopened to and from the field in the cooler with the sample containers.

2.3.3 Chain-of-Custody, Sample Packaging, and Transport

Chain-of-custody (COC) and sample packaging procedures were in accordance with the QAPP (LTMRP, Appendix A; Integral 2013a). COC forms were used to track sample custody from the time of collection through transfer to the analytical laboratory. Completed COC forms are located within the laboratory data package (see Section 3).

Individual sample jars were labeled and placed into plastic bags and sealed. Samples were then packed into a cooler, which was lined with a large plastic bag. Glass jars were placed in a manner to prevent breakage and separated in the cooler by bubble wrap. Ice in sealed, double plastic bags was placed in the cooler for sample storage during sampling and for transport to the analytical laboratory. Field personnel transported and transferred custody of the samples directly to the analytical laboratory at the end of the sampling event.

2.3.4 Investigation-Derived Waste

All investigation-derived waste was handled in accordance with the QAPP (LTMRP, Appendix A; Integral 2013a). Any excess water or sediment remaining after processing was returned to the slip in the vicinity of the collection site. Any water or sediment spilled on the deck of the sampling vessel was washed into the surface waters at the collection site before proceeding to the next station.

All disposable materials used in sample collection and processing, such as paper towels and disposable coveralls and gloves, were placed in heavyweight garbage bags or other appropriate containers. Disposable supplies were removed from the site by sampling personnel and placed in a normal refuse container for disposal at a solid waste landfill. Phosphate-free detergent-bearing liquid waste from decontamination of the sampling equipment was washed overboard or disposed in the sanitary sewer system.

2.3.5 Field Deviations

With the following exceptions, all sample collection, processing, and handling were conducted in accordance with the LTMRP (Integral 2013a):

- Slope Cap Sample Collection – As indicated in Section 2.3.1.1, the three-point composite samples for each slope cap sample location were to be collected at approximately +2, +8, and +12 ft MLLW; however, sediment from the +2 ft MLLW elevation was located within the waterway cap area and did not represent slope cap material. Therefore, slope cap material was collected from an elevation of +4 ft MLLW. This deviation did not impact the quality of the data, as the same modification was made for these locations during the post-construction confirmation sampling of 2012, and sediment from the +4 ft MLLW elevation was representative of the slope cap material.

- Packaging for Transport – The sample coolers were not labeled or packaged for transport via an independent shipper, but were transported directly to the laboratory by field personnel after completing sample collection. This deviation did not impact the quality of the data, as the samples were delivered directly and COC was transferred in person along with the samples.

- Cooler Temperature – All cooler temperatures were within the acceptance limits of 4±2˚C when they arrived at the laboratory, except for one cooler with a temperature of 1.5˚C. This slight deviation in cooler temperature did not affect the data usability.

2.4 INSTITUTIONAL CONTROLS

Institutional controls are required at the Slip 4 EAA because some hazardous substances remain onsite at levels that do not allow for unrestricted use of the property (USEPA 2006). An institutional control implementation plan was developed and presented in the final design analysis report (Integral 2010) and further developed in the RACR (Integral 2012).

Institutional control implementation has been documented in the institutional controls implementation report (ICIR) that was approved by EPA on November 27, 2013 (Integral 2013b). The ICIR documents the implementation of each institutional control, including copies of all relevant paperwork (i.e., easements, covenants, state registries, and public advisories). Amendment 1 to the ICIR (SCL 2014) contains the final Boeing Company Environmental Covenant and was submitted to and approved by EPA on January 14, 2014.

Table 2-5 summarizes the current status of the institutional controls for the Slip 4 EAA. Aspects of the institutional controls not completed to date include the following:

- Property Purchase: Filing of the First South Properties, Inc., lot line adjustment with the King County Recorder's office. The lot line adjustment transfers ownership of a 0.23-acre area of First South Properties land that contains a small sliver of the sediment cap on the east side of the slip. The lot line adjustment is included in Ordinance 124219, approved by the Seattle City Council on July 8, 2013, and is reflected in the City's Environmental Covenant for the Slip 4 EAA, which was filed with the County Recorder on September 24, 2013. First South Properties received land use approval from the Seattle Department of Planning and Development on January 14, 2014. This approval is required prior to filing the lot boundary adjustment with the King County Recorder.
- Regulated Navigation Area: Establishment of the Slip 4 regulated navigation area (RNA). An RNA is a water area within a defined boundary for which regulations for vessels navigating within the area have been established under the Code of Federal Regulations (CFR) 22 Part 165. The City applied for an EPA-sponsored RNA demarcation for the sediment cap in Slip 4. The purpose of the RNA is to protect the integrity of the Slip 4 EAA sediment cap by prohibiting activities that will disturb the cap surface, such as anchoring, grounding, or spudding. It will not affect vessel transit or navigation of the area. The RNA was approved by the Seattle City Council on July 8, 2013, as part of Ordinance 124219, which was signed by the Mayor of Seattle on July 16, 2013, and filed with the City Clerk on July 17, 2013 (Integral 2013b). The RNA is currently awaiting final U.S. Coast Guard (USCG) district command review and signature. Following USCG approval, the draft Proposed Rule regarding the RNA will be published in the Federal Register (Klinger 2013, pers. comm.). Following the public comment periods for both the draft and final Proposed Rule, the Final RNA Rule will be published in the CFR (Klinger 2013, pers. communication). The Final Rule as published in the CRF will address comments received during the public comment periods, as

appropriate. The RNA and its regulations will also be described in the Notice to Mariners and in updates of the Coast Pilot under the specific CFR reference number (e.g., CFR-165-####). The RNA will also be indicated in magenta-colored hashing on navigational charts of Slip 4, and will include the CFR reference number.

- RNA Notification Signs: The installation of signs at the mouth of Slip 4 and near the cap boundaries notifying vessel operators of the presence of the sediment cap and noting the prohibition against its disturbance was completed on August 19, 2013; however, the last four digits of the RNA CFR number will not be known until the RNA is published in the Federal Register. Once those numbers have been established, they will be installed on the notification signs.

Documentation of the completion of these institutional controls will be provided in addenda to the ICIR.

3 LABORATORY ANALYSIS

Samples collected for the Year 1 monitoring of Slip 4 were analyzed by Analytical Resources, Inc., located in Tukwila, Washington. Samples were analyzed for chemical constituents and conventional parameters as described in Section 2.3 of the QAPP (LTMRP, Appendix A; Integral 2013a) and listed in Table 1-3.

3.1 SAMPLE ANALYSIS

Slope cap (SC-2 and SC-3) and waterway cap (WC-1 through WC-4, WC-7, and WC-8) samples were analyzed for conventional parameters (total solids, grain size, and TOC), metals (arsenic, cadmium, chromium, copper, lead, mercury, silver, and zinc), PCBs, and select SVOCs (see Table 1-3). Boundary area (BD-2 and BD-7) samples were analyzed for conventional parameters (total solids and TOC) and PCBs. The laboratory analytical report is presented in Appendix F.

3.2 ANALYTICAL METHODS

All samples were analyzed in accordance with the analytical methods referenced in Table A-1 of the QAPP (LTMRP, Appendix A; Integral 2013a), except for total solids, which is discussed in the following section.

3.3 LABORATORY DEVIATIONS

All laboratory procedures for sample handling, analyses, and reporting followed the methods and procedures identified in the QAPP (LTMRP, Appendix A; Integral 2013a), except for the analytical method used for the determination of total solids. Total solids were analyzed in accordance with Standard Method 2540G (APHA *et al.* 1997) rather than the Puget Sound Estuary Program method (USEPA 1986) referenced in the QAPP. Both methods utilize a drying temperature of 103˚C, and are considered comparable for the determination of total solids in sediments; thus, the deviation did not adversely impact the quality or representativeness of the total solids results.

4 DATA MANAGEMENT AND QUALITY ASSESSMENT

Field and laboratory data management and validation were conducted in accordance with the QAPP (LTMRP, Appendix A; Integral 2013a) as described in the following sections.

4.1 DATA MANAGEMENT

Documentation of field sampling was completed in accordance with the guidelines for entry of information (Section 1.9 of the QAPP; LTMRP, Appendix A; Integral 2013a). Following the field sampling event, hard copy notes and forms were scanned to create an electronic record for use in creating appendices to this report. Information on sampling locations, dates, depths, equipment, and other conditions, and sample identifiers, were entered into a project database (e.g., Environmental Quality Information System) managed by Integral. One hundred percent of hand-entered data were verified based on hard copy records. Electronic QA checks to identify anomalous values were conducted following data entry.

The analytical laboratory submitted data in both electronic and hard copy format. Quality assurance checks of format and consistency were conducted on electronic documents received from the laboratory. No inconsistencies or issues were found during the quality assurance check of the laboratory electronic deliverables, and data were loaded into the project database. Each data set loaded into the database was linked to the electronic document of the relevant laboratory data package. A complete laboratory data deliverable was then produced from the database in an electronic format for use by data validators. Validators returned an edited version of this data deliverable, and the edits were incorporated into the database in accordance with the QAPP (LTMRP, Appendix A; Integral 2013a).

Within five business days of EPA's approval of this monitoring report, the project data will be submitted to Ecology for incorporation into the state's Environmental Information Management database, and written notification of the data upload will be sent to EPA, per Section 5.1 of the LTMRP (Integral 2013a).

4.2 DATA QUALITY ASSESSMENT

Field data were verified during preparation of samples and COC forms, which were reviewed daily by the field lead. Data verification and validation of laboratory data was conducted by EcoChem, located in Seattle, Washington, in accordance with the QAPP. Several results were qualified as estimates (assigned a *J* qualifier) during data validation. All TOC results were assigned *"J"* qualifiers during data validation due to a matrix spike recovery value (59.6 %) below the project control limit, indicating a potential low bias. Additionally, results for benzo(g,h,i)perylene, n-nitrosodiphenylamine, dibenz(a,h)anthracene, and indeno(1,2,3-

c,d)pyrene in sample WC-3 were assigned *"J"* or *"UJ"* qualifiers during data validation due to matrix spike recovery values below the project control limit, indicating a potential low bias. The benzoic acid result for sample WC-3 was assigned a *"J"* qualifier during data validation due to a matrix spike recovery value below the project control limit, indicating a potential low bias, and a matrix spike duplicate relative percent difference (RPD) greater than the project control limit. One sample result for butylbenzyl phthalate (sample WC-2) and five sample results for Aroclor 1248 (SC-2, WC-1, WC2, WC2 field replicate, and WC-4) were flagged *"Y"* by the laboratory indicating that the analyte was not detected and is associated with an elevated reporting limit due to the presence of non-target background interference; these samples were qualified as not-detected *"U"* during data validation. All data are considered acceptable for their intended use, as qualified. The data validation report is presented in Appendix G.

Field QC samples were used to assess sample variability and evaluate potential sources of contamination. Field QC samples analyzed included one field split sample and one equipment filter wipe, as described in Section 2.3.2.2.

The field split sample was collected at station WC-2; results are presented in Table 4-1. In accordance with Section 4 of the QAPP, results for field splits are evaluated against an RPD control limit of 50. The RPD value for di-n-octyl phthalate was greater than the control limit at 72 RPD. Benzoic acid was detected in the parent sample, but was not detected in the duplicate sample. In accordance with the QAPP, no data were qualified as a result of the split sample results.

One processing equipment filter wipe, sample FW0900, was submitted for chemical analysis (Table 4-1). BEHP was detected in the equipment wipe. All sample results for BEHP were either greater than 5 times the amount detected in the field blank or not detected; therefore, qualification of data was not necessary. Copper and zinc were also detected in the equipment wipe. All sample results were greater than five times the contamination level for copper and zinc; therefore, qualification of data was not necessary.

The filter blank, sample FB0900, was archived at the analytical laboratory pending results from the equipment filter wipe sample. Filter blank samples are analyzed in the event that the equipment filter wipe sample results indicate a potential issue with cross-contamination (i.e., detected chemical concentrations at levels that may impact sediment sample results). The filter blank separates out potential filter wipe background concentrations from potential cross-contamination from the equipment used. Analysis of the filter blank was not required for this sampling event (see Table 4-1).

5 RESULTS AND CONCLUSIONS

Long-term monitoring data for the Slip 4 EAA were evaluated by analyzing spatial and temporal trends in the physical and chemical characteristics of the sediments and shoreline soils. The 2012 post-construction data compiled in the RACR (Integral 2012) provides a baseline for comparison to long-term monitoring program results. The physical and chemical characteristics of the Slip 4 EAA and temporal changes identified during the Year 1 monitoring are described below. Analytical results from Year 1 sampling and baseline 2012 sampling activities are presented in Tables 5-1 and 5-2 for Slip 4 EAA and boundary area samples, respectively. Temporal changes were evaluated to identify recommendations for subsequent monitoring events.

5.1 PHYSICAL CHARACTERISTICS

The physical characteristic of concern for the Slip 4 EAA remedy is the integrity of the cap. Mechanisms for potential adverse impacts to the cap include:

- Sloughing of cap material in sloped areas (located onshore and nearshore) caused by erosion or seismic (earthquake) activity
- Erosion of waterway cap material and armoring due to outfall discharge
- Breaching of the sediment cap either onshore or within the waterway caused by manmade events, such as vessel groundings, prop-scour, or other unauthorized physical disturbances.

Other physical characteristics and processes of interest at the Slip 4 EAA include:

- Deposition of sediments from offsite sources on the sediment cap
- Evidence of recontamination
- Changes to shoreline development along the perimeter of the Slip 4 EAA
- Changes to constructed habitat features
- Re-establishment of intertidal aquatic habitat
- Accumulation of organic matter and manmade litter
- Wildlife usage.

For the Year 1 monitoring, the visual inspection was the primary means of assessing cap integrity, sediment deposition, changes in constructed habitat features, and changes to shoreline development. Photographs and field notes from the Year 1 visual inspection and sediment sampling were compared to baseline site photographs and baseline confirmation sediment sampling field notes from 2012 to evaluate physical temporal changes. Visual inspection field notes are summarized in Table 2-2 and photographs are presented in Appendix C. Baseline photographs taken in 2012 are included in Appendix C for comparative purposes. Sediment sampling field notes from baseline and Year 1 monitoring, including additional physical observations, are summarized in Table 2-4; original Year 1 monitoring field forms are presented in Appendix D, and photographs of surface sediments collected during the Year 1 monitoring are presented in Appendix E.

Temporal changes in physical characteristics noted during Year 1 monitoring were limited to the following:

- Increased vegetation was observed along the head of Slip 4 and in the vicinity of constructed habitat features (e.g., anchored woody debris).
- Accumulation of fine silts, generally less than or equal to 1 cm in depth, was observed at low tide throughout the Slip 4 EAA below the high tide line during the visual inspection (see Table 2-2), with greater accumulations within the armored outfall area. Deeper layers of overlying silt were noted during sediment collection (see Table 2-4) at WC-3 (2 and 8 cm), WC-4 (5 cm), WC-7 (5 cm), and WC-8 (2 cm); and at boundary area sediment locations BD-2 (4 cm) and BD-7 (10 cm). A discussion of fine silt accumulation within Slip 4 is provided below.
- Small woody debris (sticks, twigs, and trace leaf litter) were noted along the north and east slope cap areas.
- Trace litter and plastic debris were observed along the north sediment cap.
- Algae growth was observed along the entire intertidal area of the Slip 4 EAA. The presence of sea lettuce was noted along the armored outfall cap area.
- Evidence of re-establishment of intertidal aquatic habitat was limited to: Barnacles observed attached to cobble and gravel along the outfall cap area and west cap area; worms observed when collecting surface sediments from WC-1 and WC-2; mussels observed at WC-3, WC-8, and BD-2; and one amphipod observed within the top 2 cm of sediment at WC-4.
- Wildlife observations during the Year 1 monitoring included avian and insect activity as follows: A great blue heron was observed hunting along the waterline of the west sediment cap area; crows were observed feeding along the intertidal areas of the cap; bird droppings were noted along the western intertidal area and northwest pocket beach; feathers were noted along the northwest pocket beach; flies were observed along the intertidal areas of the cap; and small burrow openings were observed within the fine sediments along the west sediment cap.

Sedimentation rates within Slip 4 were estimated at 2 to 3 cm/year, with thicker accumulations occurring in the former inner berthing area (along the bulkhead of removal areas RA5 and RA7; Figure 1-2). This is an indication of variability in deposition rates within Slip 4 (Integral 2006). As described above, Year 1 sediment accumulation within the Slip 4 EAA varied within the slip. Accumulations of 0 to 1 cm were observed within the slope cap and northern outfall cap areas (near sample location WC-1; Figure 5-1). Accumulations of 2 to 8 cm were observed within the southern outfall cap and waterway cap areas (near sample locations WC-3 and WC-4; Figure 5-1). Accumulations are not always uniform, even within small areas, and may reflect periodic disturbances such as prop wash. For example, two sediment grabs were collected at WC-3 with one grab containing 2 cm of overlying fine sediment and the other containing 8 cm of overlying fine sediment. The remaining berthing areas adjacent to 8th Avenue Terminals are periodically dredged and may also experience greater sedimentation rates.

This variability in local sedimentation rates is comparable to the LDW sediment transport modeling predictions for Slip 4 (AECOM 2012), which predicted lower sedimentation rates within the inner portions of Slip 4 (EAA) and higher sedimentation rates between the EAA and the mouth of Slip 4. In addition, there are a number of potential sources of sediments to Slip 4 as follows:

- **Outfall discharges.** There are six outfalls located within the Slip 4 EAA (Figure 5-1). Each is described below along with an indication of whether the outfall is a potential source of sediment:
  - The I-5 storm drain, owned by the Washington State Department of Transportation, which collects runoff from I-5, residential properties, and the north end of the King County Airport (Integral 2006). Given the size of the drainage basin and the lack of stormwater treatment, this outfall is a likely source of sediment to Slip 4.
  - The King County Airport storm drain, owned by King County, which functions as an emergency sewer overflow for City pump station 44 (Integral 2006). City records dating back to 2001 indicate that this overflow has not discharged in the last 12 years and is not considered a source of sediment to Slip 4 (Schmoyer 2014, pers. comm).
  - The NBF storm drain, owned by Boeing, which is treated by the LTST system. As noted earlier, approximately 68 percent of the stormwater discharged from this outfall was treated during the first year of the LTST system operations. This outfall may be contributing some sediments to Slip 4.
  - The GTSP storm drain, owned by the City, which conveys stormwater from a small portion of the GTSP property and is not considered a significant source of sediments to Slip 4.
  - Two private storm drains/piped outfalls serving 8th Avenue Terminals and First South Properties. Both outfalls are small and are not considered significant sources of sediments to Slip 4.

- **Sediments from outside the remediation area.** Operations at 8th Avenue Terminals include the movement of barges and vessels just outside of the EAA in an area with relatively shallow bathymetry (-15 to -20 ft MLLW). It is likely that propwash-induced resuspension of sediments is occurring and may be the most significant source of newly deposited sediments in the EAA. Sediment migration into the slip from the main stem of the LDW is also a likely source of sediment to Slip 4.
- **Boeing Plant 2 dredging.** Boeing Plant 2 perimeter dredging was conducted in early 2013 (Jan-March, as discussed in Section 5.3). During the 31 days of dredging activity there were two confirmed exceedances and one unconfirmed exceedance of the turbidity water quality criterion (AMEC 2013). The two confirmed turbidity exceedances were only slightly above the criterion (i.e., 9.7 nephelometric turbidity units [NTUs] versus an ambient criterion of 8.5 NTUs, and 8.9 NTUs versus an ambient criterion of 8.7 NTUs). The 2013 Boeing Plant 2 dredging activity is not considered to be a likely source of depositional sediments for Slip 4.
- **Slip 4 EAA sediments.** All sediments, including bank sediments, within the Slip 4 EAA were covered with clean capping material, varying in thickness between 24 and 60 in., as shown in Figure 1-2. The visual observations noted during the site walk at extreme low tide indicate that the integrity of the cap is intact; thus, the capped Slip 4 EAA sediments are not contributing to the depositional sediments within the EAA.

In summary, sediment deposition within Slip 4 is not uniform and sediments are likely being redistributed within Slip 4 and the EAA due to propwash-induced resuspension, tidal fluctuations, and (to a lesser degree) storm drain outflows.

Based on observations during the visual inspection and sediment sampling activities, the physical integrity of the Slip 4 EAA cap is intact. There were no indications of breaches to the cap integrity or evidence of pollution at the time of the Year 1 visual inspection, and no changes in structural integrity were observed for any of the constructed habitat features within the Slip 4 EAA.

5.2 CHEMICAL CHARACTERISTICS

The RAO within the Slip 4 EAA is to reduce concentrations of contaminants of concern in surface sediment to levels that do not exceed the SQS. Mechanisms that could potentially cause SQS exceedances of one or more of the contaminants of concern include:

- Reduction in thickness or breaching of the cap that exposes underlying sediments containing residual contaminants
- Recontamination of Slip 4 EAA sediments by deposition of contaminants from offsite sources

- Migration of contaminants upward through the cap materials.

Sediment sampling and analyses were used to assess compliance with the Slip 4 EAA RAO and to document temporal changes in surface sediment chemical and physical (i.e., grain size and total solids) characteristics. Analytical results from Year 1 sampling and baseline 2012 sampling activities are presented in Tables 5-1 and 5-2 for Slip 4 EAA and boundary area samples, respectively.

Overall, chemical concentrations within the Slip 4 EAA and boundary area have increased when compared to 2012 post-construction baseline concentrations. This increase is not unexpected given that the 2012 post-construction concentrations represent baseline conditions of the clean imported capping materials. Figure 5-2 shows changes in concentrations of PCBs, BEHP, and total high molecular weight PAHs between the baseline sampling in 2012 and Year 1 monitoring in 2013. Concentrations are consistently higher in 2013.

Within the Slip 4 EAA, there were two minor exceedances of the SQS (Table 5-1). Station WC-3 had a total PCB concentration of 12.3 mg/kg OC (compared to the SQS of 12.0 mg/kg OC); and Station WC-1 had a BEHP concentration of 47.9 mg/kg OC (compared to the SQS of 47 mg/kg OC). No samples exceeded the CSL. Outside of the EAA, there was one exceedence of the SQS. The total PCB concentration at Station BD-7 (a boundary area station) was 410 µg/kg (compared to the SQS of 130 µg/kg[1]). The 2012 (Integral 2013c) and 2013 (AMEC 2013) samples collected in the outer portion of Slip 4 also had exceedances of the PCB SQS (Figure 5-3).

PCB concentrations in sediment samples collected in 2012 and 2013 vary considerably throughout Slip 4 (Figure 5-3). PCB concentrations in the EAA were generally very low compared with concentrations in the outer portion of the slip. Table 5-3 provides ranges of total PCBs and BEHP concentrations (where available) within the EAA; in the boundary area; between the boundary area and the mouth of the slip; and just outside the mouth of the slip. Prior to construction, PCBs in the EAA ranged from 232 to 8,200 µg/kg. During Year 1 monitoring (including data collected by Boeing [AMEC 2013]) the range of PCBs in the EAA was substantially lower (i.e., 3.7U to 490 µg/kg). BEHP concentrations followed a similar trend, with pre-construction concentrations ranging from 360 to 5,000 µg/kg and post-construction concentrations in Year 1 ranging from 48U to 1,800 µg/kg.

As mentioned in Section 1.3, two locations within the boundary area were sampled as part of the Year 1 monitoring effort to evaluate whether conditions outside of the Slip 4 EAA have changed since baseline samples were collected in 2012. Year 1 PCB concentrations at boundary area Stations BD-2 and BD-7 (154 µg/kg and 410 µg/kg, respectively) were greater than baseline concentrations (14U and 3.8U, respectively; Figure 5-3). Boundary area Year 1 concentrations

[1] PCBs at Station BD-7 were compared to the lowest apparent effects threshold because the TOC concentration was outside of the 0.5 to 4.0 percent range for organic carbon normalization

were within the range of 2012-2013 concentrations in the EAA (ranging from 3.7U to 490 µg/kg) and within Slip 4 beyond the boundary area (as discussed below).

In the outer portion of Slip 4, beyond the boundary area, 2012 and 2013 PCB concentrations ranged from 133 to 620 µg/kg. The upper end of this range is similar to that observed during Year 1 monitoring in the EAA and boundary area, indicating that sediments from the outer portion of Slip 4 are a likely source of new sediment deposition in the EAA, especially given the movement of barges in the outer portion of the slip. Additionally, 2012 and 2013 total PCB concentrations in the LDW near the mouth of Slip 4 ranged from 92 to 233 µg/kg, and may also be a source of sediment deposition within the Slip 4 EAA.

Phthalate concentrations above SQS criteria are ubiquitous within the LDW. The Sediment Phthalates Work Group (SPWG 2007) provided a summary of findings relating to phthalate accumulation in sediments that indicates an air-stormwater-sediment pathway, with urban or metropolitan areas as ongoing sources due to the use of plasticized products. Given the existing source controls in place for the major outfalls within the Slip 4 EAA, concentrations of BEHP in Slip 4 EAA sediments are likely associated with sediment deposition from the outer portion of Slip 4.

5.3 OTHER SEDIMENT INVESTIGATIONS

In accordance with the LTMRP, monitoring and construction activities controlled by others within the vicinity of Slip 4 that took place between the Year 1 monitoring period (February 2012 through July 2013) were reviewed to assess any effects on the performance of the Slip 4 EAA remedy. There were two projects active within Slip 4 during the Year 1 monitoring period: 8th Avenue Terminals sediment sampling (Integral 2013c); and Boeing Plant 2 Duwamish Sediment Other Area (DSOA) Corrective Measure Project (AMEC 2013); both of which are summarized below. Total PCB and TOC data from these sediment investigations are presented along with Slip 4 Year 1 monitoring data in Figure 5-3.

5.3.1 8th Avenue Terminals

On October 31, 2012, the City conducted sediment sampling within Slip 4 in an area outside of the Slip 4 EAA, adjacent to the Crowley Maritime 8th Ave Terminals (Integral 2013c). Sampling was conducted to assess whether PCBs in surface sediment exceeded the Washington State Sediment Management Standards; and to compare existing and historical conditions in the 8th Avenue Terminals' berth area.

Five surface sediment samples were collected and analyzed for PCBs, grain size, TOC, and total solids. Sample locations and data from the 2012 8th Avenue Terminals' sampling event are presented in Appendix H. In summary, two of the five samples analyzed for PCBs exceeded the SQS (i.e., Stations SL4-3 and SG-18).

Data obtained from this sampling effort may be used for comparison purposes for future monitoring events.

5.3.2 Boeing Plant 2

Boeing is conducting the DSOA Corrective Measure Project pursuant to the Administrative Order [Resource Conservation and Recovery Act (RCRA) Docket No 1092-01-22-3008(h)] on Consent (Order) issued to Boeing in 1994 by EPA under authority of the RCRA Section 3008(h), as amended [42 USC 6928(h)]. Dredging of the DSOA began on January 4, 2013, with all in-water work completed by March 8, 2013. Sediment removal and placement of backfill was completed within the dredge units shown in Figure 3 of Appendix I. A portion of the Boeing sediment cleanup was scheduled to occur within Slip 4 during construction season 1 (2012-2013); however, dredging within Slip 4 was postponed because property access agreements were not obtained in time to dredge this area within the construction time-line.

As a requirement of the RCRA Order, Boeing conducted a pre- and post-construction perimeter sediment monitoring program to determine if there were material increases in concentrations of contaminants of concern in the post remediation perimeter surface sampling areas outside the DSOA relative to the pre-remediation concentrations (AMEC 2013).

Perimeter surface sampling areas included 3 locations within the City of Seattle-owned portion of Slip 4 (SD-PER501, SD-PER502, SD-PER503) and 15 locations within Slip 4 between the EAA and the mouth of the Slip; 3 of which are located within the boundary area just outside of the Slip 4 EAA. Boeing's perimeter monitoring locations are shown in Figure 4 of Appendix I.

Surface sediment samples (top 10 cm) from the perimeter monitoring stations were collected for analysis of contaminants of concern identified by EPA for the project (i.e., cadmium, chromium, copper, lead, mercury, silver, zinc, and PCBs). TOC was also measured in each sample. Perimeter monitoring sample results for construction season 1 (2012-2013) are presented in Table 9-5 of Appendix I and are summarized as follows (AMEC 2013):

- SD-PER501 and SD-PER502 – Pre-construction sample results were greater than post-construction sample results for metals and total PCBs. No results exceeded the SQS at this location.
- SD-PER503 – Post-construction sample results were greater than pre-construction sample results for metals and total PCBs. The post-construction PCB result exceeded the SQS at this location.
- SD-PER504 – Post-construction sample results were comparable to pre-construction sample results for all analytes. No results exceeded the SQS at this location.
- SD-PER508 (Slip 4 EAA BD-5) and SD-PER509 (Slip 4 EAA BD-6) – Post construction sample results in the Slip 4 EAA boundary area were greater than pre-construction

sample results for total PCBs. No results exceeded the SQS at these locations. Changes in concentrations for metals could not be evaluated because pre-construction samples at these locations were not submitted for metals analyses.

- Samples collected between the EAA boundary area and mouth of Slip 4 –Boeing collected post-construction samples from the five 8th Avenue Terminals' locations (i.e., SG-18, SG-20, SG-21, SG22, and SL4-3) sampled by the City initially in October 2012 (see Section 5.3.1), and used the City's data to represent pre-construction conditions for those locations. Pre- and post-construction data were reported for total PCBs at 9 of the 12 remaining perimeter locations, and for metals in 4 of the 12 remaining perimeter locations as summarized below:
  - Total PCBs – All post-construction results for total PCBs were greater than pre-construction results, except for samples SD-PER505, SD-PER510 (corresponding to 8th Avenue Terminals' sampling location SG-18), and SD-PER511 (corresponding to 8th Avenue Terminals' sampling location SL4-3). Post-construction total PCB results were less than pre-construction results at these locations. Pre- and post-construction total PCB concentrations exceeded the SQS at sampling locations SD-PER505 and SD-PER511 (SL4-3). Post-construction total PCB concentrations exceeded the SQS at sampling locations SD-PER514 (SG-22) and SD-PER515 (SG-21), with pre-construction sampling concentrations reported below the SQS. Pre-construction total PCB concentrations exceeded the SQS at sampling location SD-PER510 (SG-18), with post-construction concentrations reported below the SQS.
  - Metals – Of the four locations with pre- and post-construction sampling results for metals, sample locations located at the confluence of the slip with the Duwamish Waterway (SD-PER507 and SD-PER512) were variable. Post-construction metals results for the samples located within the slip (SD-PER505 and SD-PER506) were comparable to pre-construction concentrations. No metals results exceeded their respective SQS values.

Data obtained from this and subsequent sampling efforts may be used for comparison purposes for future monitoring events. Boeing DSOA construction activities are scheduled to continue in 2013-2014 and 2014-2015.

5.4 ASSESSMENT OF LONG-TERM MONITORING OBJECTIVES

As stated in Section 1.1, the long-term success of the sediment removal action for the Slip 4 EAA is to reduce the concentration of contaminants in post-cleanup surface sediments (0–10 cm) to below the SQS for PCBs and other chemicals of interest, thereby reducing risks to human health and the environment resulting from potential exposure to contaminants in sediments in the Slip 4 EAA (USEPA 2006). Specific study questions that address the monitoring program objectives are discussed in this section with respect to the Year 1 monitoring results:

- **Are contaminant concentrations in Slip 4 EAA surface sediments (0–10 cm) below the SQS?** As discussed in Section 5.2, all chemical concentrations were below the SQS, except for total PCBs at Station WC-3 and BEHP at Station WC-1 (see Table 5-1). In addition, one Slip 4 EAA location sampled by Boeing (SD-PER503) exceeded the SQS for total PCBs. As discussed in Section 5.2, the SQS exceedances were minor, with Year 1 total PCB and BEHP concentrations within the EAA significantly lower than pre-construction concentrations. Year 1 EAA total PCB concentrations are within the range found in sediments beyond the boundary area within Slip 4, indicating that this area is a likely source of new sediments containing elevated PCBs to the EAA. BEHPs detected within the EAA are not surprising given how ubiquitous the compound is within sediments in urban and industrial settings (SPWG 2007).

- **Is the physical integrity of the cap in the Slip 4 EAA being maintained such that the sediment cap continues to isolate contaminants in underlying sediments from marine biota?** Visual inspection results (Sections 2.2 and 5.1) indicate that the Slip 4 EAA sediment and beach caps are fully functional, in good condition, and continue to isolate contaminants in underlying sediments from marine biota. As discussed in Section 5.1, the layer of fine sediments overlying the waterway and outfall cap areas are a result of depositional sediments not a result of cap failure.

- **Do the institutional controls associated with the Slip 4 EAA remedy remain in place and continue to work effectively?** The efficacy of the institutional controls could not be assessed with certainty for the Year 1 monitoring period, given the relative brief period of operation of the ICs and because certain controls have not been fully implemented (most notably the RNA designation, see Section 2.4). However, it is expected that the selected institutional controls for this site will satisfy the stated objectives.

- **Are physical changes occurring related to sediment erosion and sediment deposition in the Slip 4 EAA?** As discussed in Section 5.1, minor physical changes have occurred in the Slip 4 EAA within the first year post-remedy as a result of sediment deposition. Depositional sediments overlying the cap material at sediment sampling locations within the Slip 4 EAA varied between 0 and 8-cm thick, with accumulations following the bathymetric gradient (e.g., increased thickness of depositional sediments associated with areas of deeper bathymetry). Propwash-induced re-suspension of sediments from outside the Slip 4 EAA is the most likely source of depositional sediment within the Slip 4 EAA. Storm drain outflows to the EAA are also (to a lesser degree) a potential source of depositional sediment.

As mentioned in Section 1.3, two locations within the boundary area were sampled as part of the Year 1 monitoring effort in order to evaluate whether conditions outside of the Slip 4 EAA have changed since baseline samples were collected in 2012. As discussed in Section 5.2, boundary area PCB concentrations are within the 2012-2013 ranges found in sediments within the EAA and beyond the boundary area (Table 5-3) within Slip 4, indicating that the increase in PCB concentrations is likely due to depositional sediments from propwash-induced resuspension, as discussed above.

5.5 CONCLUSIONS AND RECOMMENDATIONS FOR FUTURE MONITORING

Cleanup actions within the Slip 4 EAA included the removal of approximately 10,256 cubic yards of contaminated bottom sediment and bank soil, removal of approximately 130 tons of creosote-treated timbers and piles, removal of a concrete pier structure, construction of stable slopes, sediment and slope caps over 3.43 acres using 53,000 tons of clean import material, and construction of engineered soil covers with habitat enhancements over 0.15 acre in the former upland areas. The construction of sediment and slope caps in conjunction with engineered soil covers and habitat enhancements resulted in clean material placement over all remaining contaminated soils and sediments within the Slip 4 EAA. Overall the cleanup resulted in a net gain of over an acre of shallow and riparian habitat for threatened Puget Sound Chinook and Coastal/Puget Sound bull trout. Long-term monitoring will ensure that the remedy remains protective of human health and the environment.

The objectives of the Year 1 monitoring program for the Slip 4 EAA were achieved. The investigation findings indicate that the sediment cap and backfill remain structurally stable and intact, and new sediment has begun to accumulate. Overall, chemical concentrations within the Slip 4 EAA and boundary area have increased when compared to 2012 post-remedy baseline concentrations. As discussed, this is not unexpected. Although Ecology determined that source control within the Slip 4 drainage basin was sufficient to allow the Slip 4 remedy to be implemented (Ecology 2011), source control efforts in the Slip 4 basin and overall LDW basin continue. As new sediment deposits on the clean cap surface, contaminants associated with the sediment particles will accumulate and be measured in the long-term monitoring program. To date, concentrations of this deposited material have generally remained below the SQS with only minor exceptions. Continued monitoring will document both the long-term success of the remedial action as well as track conditions associated with new sediments that deposit within the EAA.

The only proposed modification to the long-term monitoring plan is as follows:

- Slip 4 EAA Monitoring – Given that the slope cap sample composites for both the post-remedy confirmation sampling and the Year 1 long-term monitoring sampling required an adjustment from +2 ft MLLW to +4 ft MLLW, we recommend that future monitoring events automatically defer to the +4 ft MLLW elevation for the slope cap sample collection procedure.

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FIGURES

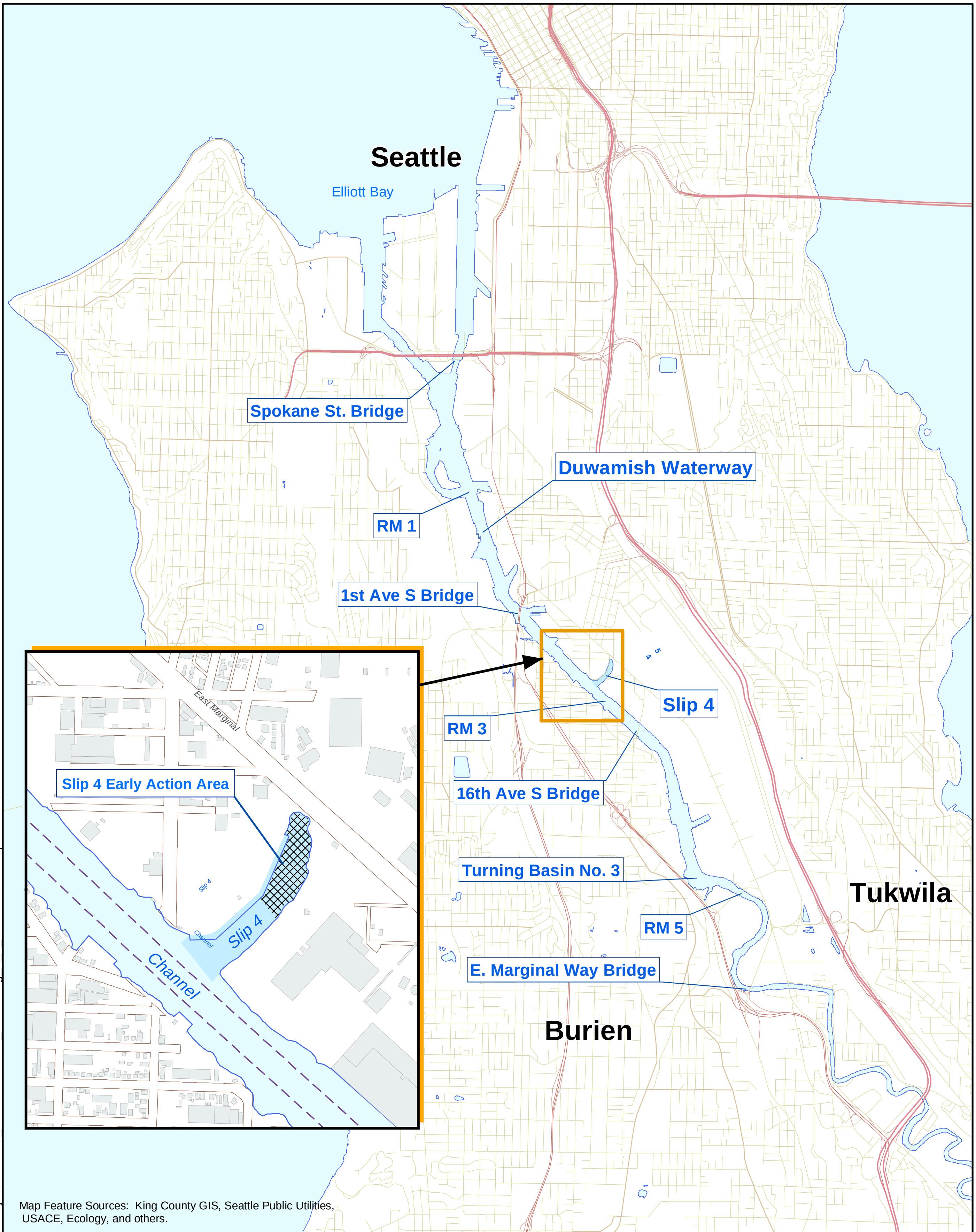

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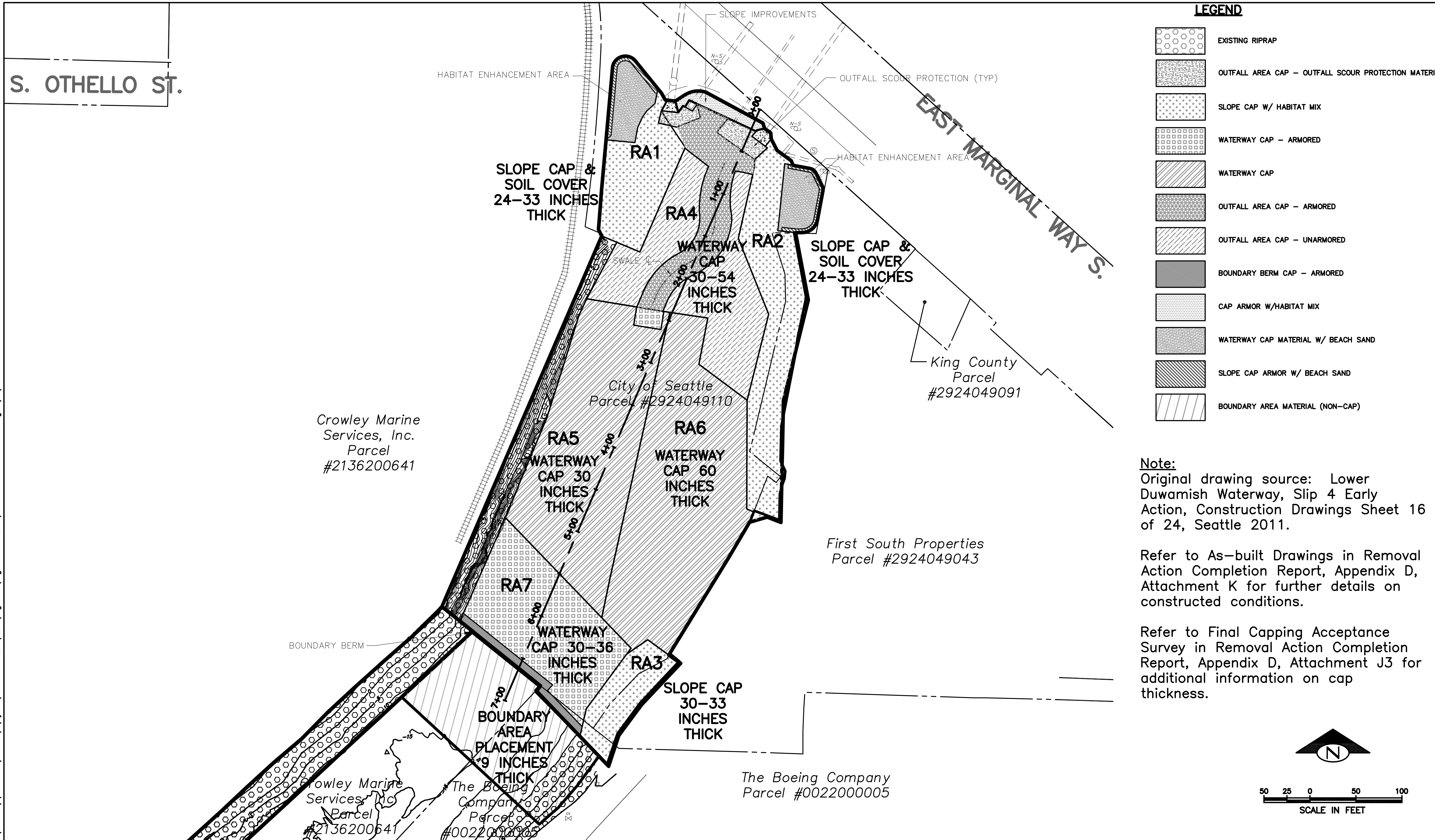
Figure 1-1.
Vicinity Map
Slip 4 Early Action Area
Long-Term Monitoring Data Report - Year 1 (2013)



Note:
Original drawing source: Lower Duwamish Waterway, Slip 4 Early Action, Construction Drawings Sheet 16 of 24, Seattle 2011.

Refer to As-built Drawings in Removal Action Completion Report, Appendix D, Attachment K for further details on constructed conditions.

Refer to Final Capping Acceptance Survey in Removal Action Completion Report, Appendix D, Attachment J3 for additional information on cap thickness.

C:\Users\epilcher4\Desktop\Sync\A000614H_Slip_4\Figures\Figure 1-3_Cap Material Locations.dwg 3/6/2013 9:58:57 AM

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Figure 1-2.
Sediment Cap and Soil Cover Design
Slip 4 Early Action Area
Long-Term Monitoring Data Report - Year 1 (2013)

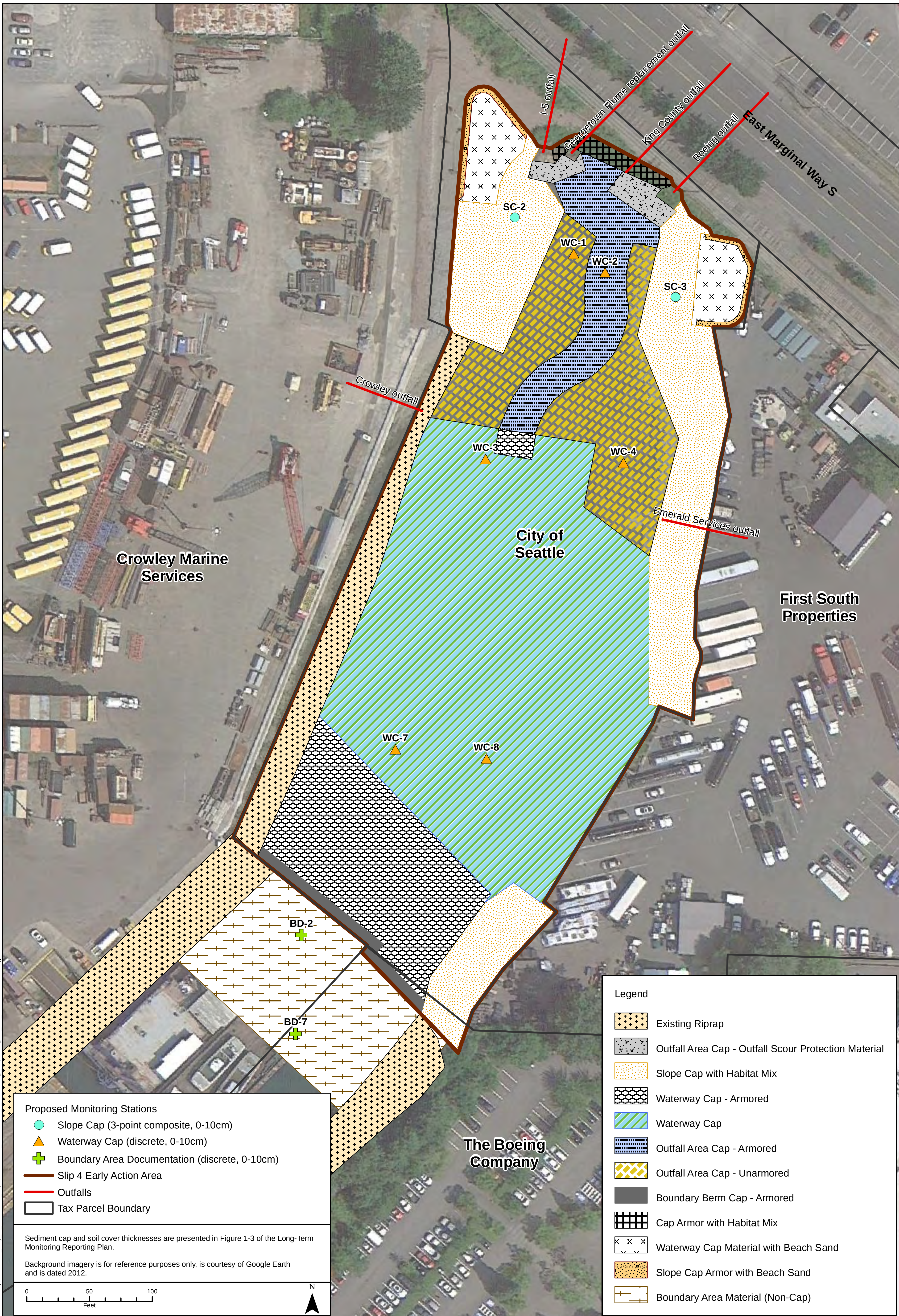

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Figure 1-3.
Sampling Locations
Slip 4 Early Action Area
Long-Term Monitoring Data Report - Year 1 (2013)

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Figure 2-1.
Visual Monitoring Station Locations
Slip 4 Early Action Area
Long-Term Monitoring Data Report - Year 1 (2013)

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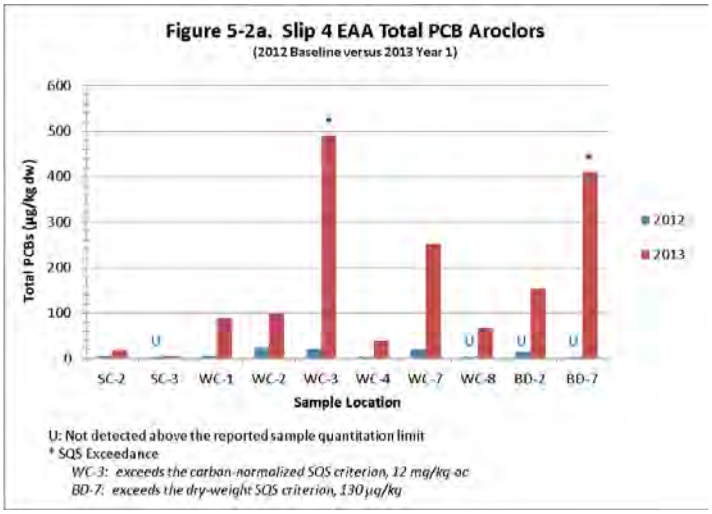
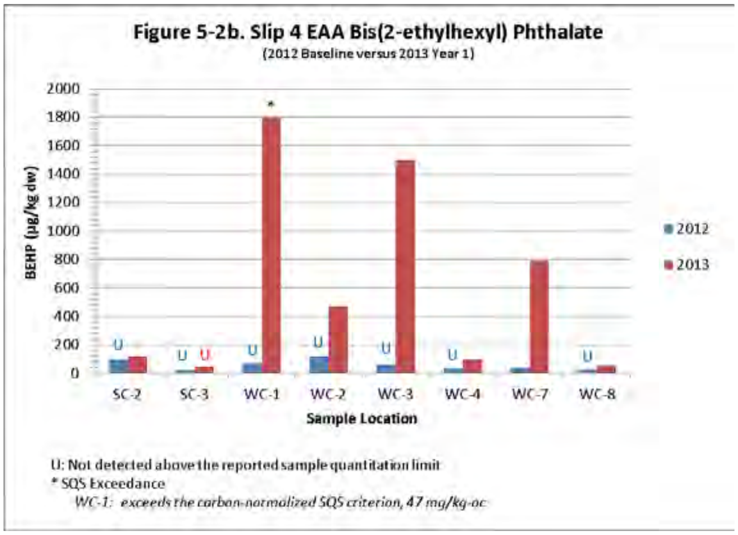
Figure 5-1.
Thickness of Accumulated Sediment on Top of Cap During Year 1 Monitoring
Slip 4 Early Action Area
Long-Term Monitoring Data Report - Year 1 (2013)





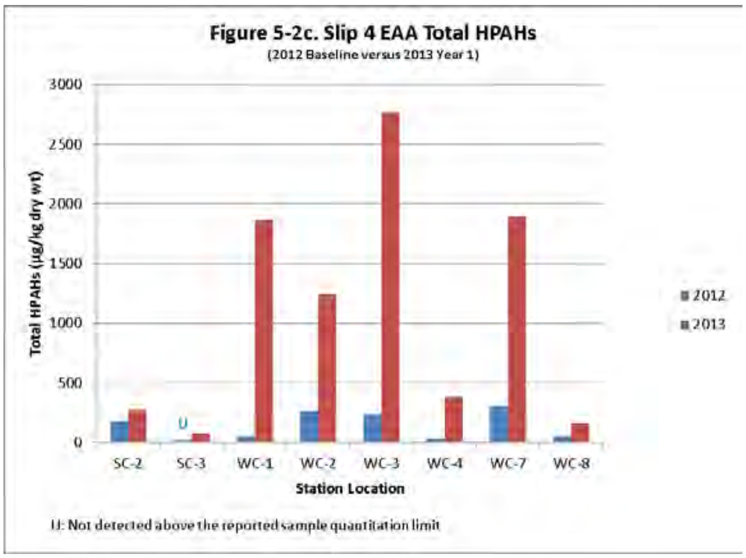
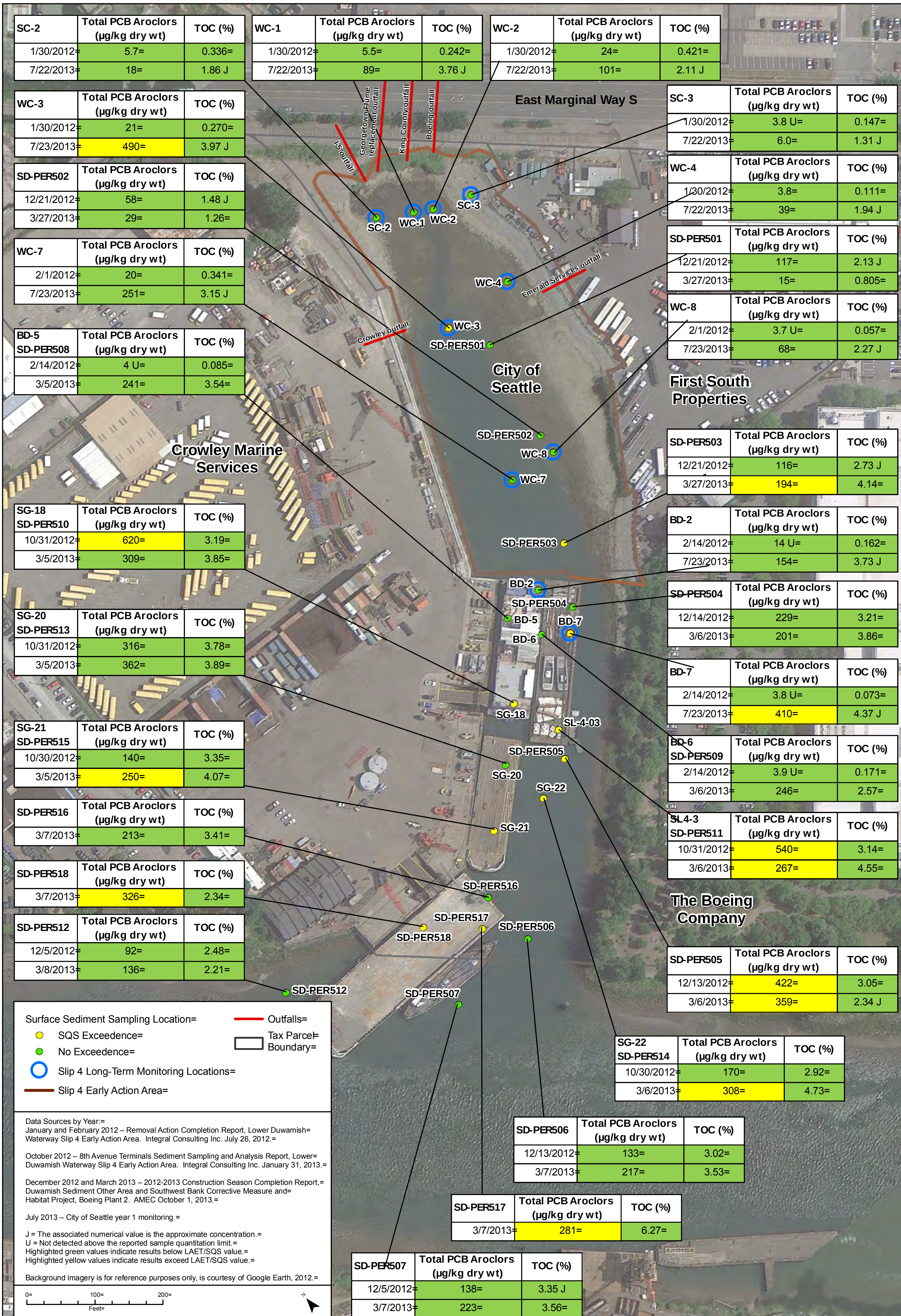


Figure 5-2.
Year 1 (2013) versus Baseline (2012)
Concentrations of Select Organic Compounds
Slip 4 Early Action Area
Long-Term Monitoring Data Report – Year 1 (2013)



SC-2	Total PCB Aroclors (µg/kg dry wt)	TOC (%)
1/30/2012=	5.7=	0.336=
7/22/2013=	18=	1.86 J

WC-1	Total PCB Aroclors (µg/kg dry wt)	TOC (%)
1/30/2012=	5.5=	0.242=
7/22/2013=	89=	3.76 J

WC-2	Total PCB Aroclors (µg/kg dry wt)	TOC (%)
1/30/2012=	24=	0.421=
7/22/2013=	101=	2.11 J

WC-3	Total PCB Aroclors (µg/kg dry wt)	TOC (%)
1/30/2012=	21=	0.270=
7/23/2013=	490=	3.97 J

SD-PER502	Total PCB Aroclors (µg/kg dry wt)	TOC (%)
12/21/2012=	58=	1.48 J
3/27/2013=	29=	1.26=

WC-7	Total PCB Aroclors (µg/kg dry wt)	TOC (%)
2/1/2012=	20=	0.341=
7/23/2013=	251=	3.15 J

BD-5 SD-PER508	Total PCB Aroclors (µg/kg dry wt)	TOC (%)
2/14/2012=	4 U=	0.085=
3/5/2013=	241=	3.54=

SG-18 SD-PER510	Total PCB Aroclors (µg/kg dry wt)	TOC (%)
10/31/2012=	620=	3.19=
3/5/2013=	309=	3.85=

SG-20 SD-PER513	Total PCB Aroclors (µg/kg dry wt)	TOC (%)
10/31/2012=	316=	3.78=
3/5/2013=	362=	3.89=

SG-21 SD-PER515	Total PCB Aroclors (µg/kg dry wt)	TOC (%)
10/30/2012=	140=	3.35=
3/5/2013=	250=	4.07=

SD-PER516	Total PCB Aroclors (µg/kg dry wt)	TOC (%)
3/7/2013=	213=	3.41=

SD-PER518	Total PCB Aroclors (µg/kg dry wt)	TOC (%)
3/7/2013=	326=	2.34=

SD-PER512	Total PCB Aroclors (µg/kg dry wt)	TOC (%)
12/5/2012=	92=	2.48=
3/8/2013=	136=	2.21=

SC-3	Total PCB Aroclors (µg/kg dry wt)	TOC (%)
1/30/2012=	3.8 U=	0.147=
7/22/2013=	6.0=	1.31 J

WC-4	Total PCB Aroclors (µg/kg dry wt)	TOC (%)
1/30/2012=	3.8=	0.111=
7/22/2013=	39=	1.94 J

SD-PER501	Total PCB Aroclors (µg/kg dry wt)	TOC (%)
12/21/2012=	117=	2.13 J
3/27/2013=	15=	0.805=

WC-8	Total PCB Aroclors (µg/kg dry wt)	TOC (%)
2/1/2012=	3.7 U=	0.057=
7/23/2013=	68=	2.27 J

SD-PER503	Total PCB Aroclors (µg/kg dry wt)	TOC (%)
12/21/2012=	116=	2.73 J
3/27/2013=	194=	4.14=

BD-2	Total PCB Aroclors (µg/kg dry wt)	TOC (%)
2/14/2012=	14 U=	0.162=
7/23/2013=	154=	3.73 J

SD-PER504	Total PCB Aroclors (µg/kg dry wt)	TOC (%)
12/14/2012=	229=	3.21=
3/6/2013=	201=	3.86=

BD-7	Total PCB Aroclors (µg/kg dry wt)	TOC (%)
2/14/2012=	3.8 U=	0.073=
7/23/2013=	410=	4.37 J

BD-6 SD-PER509	Total PCB Aroclors (µg/kg dry wt)	TOC (%)
2/14/2012=	3.9 U=	0.171=
3/6/2013=	246=	2.57=

SL4-3 SD-PER511	Total PCB Aroclors (µg/kg dry wt)	TOC (%)
10/31/2012=	540=	3.14=
3/6/2013=	267=	4.55=

SD-PER505	Total PCB Aroclors (µg/kg dry wt)	TOC (%)
12/13/2012=	422=	3.05=
3/6/2013=	359=	2.34 J

SG-22 SD-PER514	Total PCB Aroclors (µg/kg dry wt)	TOC (%)
10/30/2012=	170=	2.92=
3/6/2013=	308=	4.73=

SD-PER506	Total PCB Aroclors (µg/kg dry wt)	TOC (%)
12/13/2012=	133=	3.02=
3/7/2013=	217=	3.53=

SD-PER517	Total PCB Aroclors (µg/kg dry wt)	TOC (%)
3/7/2013=	281=	6.27=

SD-PER507	Total PCB Aroclors (µg/kg dry wt)	TOC (%)
12/5/2012=	138=	3.35 J
3/7/2013=	223=	3.56=

Surface Sediment Sampling Location=
SQS Exceedence=
No Exceedence=
Slip 4 Long-Term Monitoring Locations=
Slip 4 Early Action Area=
Outfalls=
Tax Parcel= Boundary=

Data Sources by Year:=
January and February 2012 – Removal Action Completion Report, Lower Duwamish= Waterway Slip 4 Early Action Area. Integral Consulting Inc. July 26, 2012.=

October 2012 – 8th Avenue Terminals Sediment Sampling and Analysis Report, Lower= Duwamish Waterway Slip 4 Early Action Area. Integral Consulting Inc. January 31, 2013.=

December 2012 and March 2013 – 2012-2013 Construction Season Completion Report,= Duwamish Sediment Other Area and Southwest Bank Corrective Measure and= Habitat Project, Boeing Plant 2. AMEC October 1, 2013.=

July 2013 – City of Seattle year 1 monitoring =

J = The associated numerical value is the approximate concentration.=
U = Not detected above the reported sample quantitation limit.=
Highlighted green values indicate results below LAET/SQS value.=
Highlighted yellow values indicate results exceed LAET/SQS value.=

Background imagery is for reference purposes only, is courtesy of Google Earth, 2012.=

0= 100= 200=
Feet=

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Figure 5-3.
Total PCB and TOC Concentrations for All Slip 4 Sediment= Samples Collected in 2012 and 2013=
Slip 4 Early Action Area=
Long-Term Monitoring Data Report - Year 1 (2013)=

TABLES

Table 1-1. Long-Term Monitoring Study Questions and Informational Inputs

Study Questions	Informational Inputs
Are contaminant concentrations in Slip 4 EAA surface sediments (0-10 cm) below the SQS?	• Chemical analysis of surface sediment samples from capped areas (bank and channel) • Chemical analysis of surface sediment samples from boundary material placement area
Is the physical integrity of the cap in the Slip 4 EAA being maintained such that the sediment cap continues to isolate contaminants in underlying sediments from marine biota?	• Visual inspections and photo-documentation of cap conditions at low tide • Hydrographic surveys • Topographic surveys (if required)
Do the institutional controls associated with the Slip 4 EAA remedy remain in place and continue to work effectively?	• Review status of institutional controls • Review violations and/or any notifications for variances from institutional controls • Review available information associated with any activity controlled by an institutional control
Are physical changes occurring related to sediment erosion and sediment deposition in the Slip 4 EAA?	• Visual inspections and photo-documentation of cap conditions at low tide • Hydrographic surveys • Topographic surveys (if required) • Visual observations and photo-documentation of surface sediment samples collected during long-term monitoring • Documentation of 100-year storm flow events within the monitoring period

Notes:
cm = centimeter
EAA = Early Action Area
SQS = Washington State Sediment Quality Standards

Table 1-2. Long-Term Monitoring Schedule

	Year to be Performed									
	1	2	3	4	5	6	7	8	9	10
Monitoring Activities	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022[a]
Visual Inspections[b]	X	X	X	X	X		X			X
Institutional Control Update	X	X	X	X	X		X			X
Review of Physical Construction/Investigations by Others	X	X	X	X	X		X			X
Review of Storm Flow Monitoring Data for 100-Year Events	X	X	X	X	X		X			X
Hydrographic Surveys[c,d]					X					X
Topographic Surveys[e]										
Sediment Sampling[d]										
Composite Slope Cap Samples (2)[f]	X		X		X		X			X
Discrete Waterway Cap Samples (6)[f]	X		X		X		X			X
Discrete Boundary Area Documentation Samples (2)[g]	X									

Notes:

EPA = U.S. Environmental Protection Agency

PCB = polychlorinated biphenyl

QAPP – quality assurance project plan

[a] Subsequent monitoring after year 10 will be determined upon consultation with EPA.

[b] Visual inspections will be performed after a significant seismic event (peak horizontal ground acceleration greater than 0.10 g) or as otherwise warranted based on visual observations.

[c] Multi-beam echo sounding at intervals not exceeding 20 ft, utilizing similar equipment and methods used for the removal action post-construction survey.

[d] Frequency may increase if warranted based on visual inspection.

[e] As needed based on visual inspection reports of significant physical disturbances observed (e.g., bank slope deformation) or after significant seismic events.

[f] 0-10 cm horizon. To be analyzed for all target analytes listed on Table A-1 of the QAPP (Appendix A).

[g] 0-10 cm horizon. To be analyzed for PCB Aroclors, total organic carbon, and total solids.

Table 1-3. Target Analyte List for Slip 4 Early Action Area Long-Term Monitoring

Analyte	
Polychlorinated Biphenyls	**Metals**[a]
PCB Aroclors	Arsenic
Semivolatiles[a]	Cadmium
Benz[a]anthracene	Chromium
Benzo[a]pyrene	Copper
Benzo[ghi]perylene	Lead
Benzofluoranthenes (total)	Mercury
Bis(2-ethylhexyl)phthalate	Silver
Butyl benzyl phthalate	Zinc
Chrysene	**Conventional Parameters**
Dibenzo[a,h]anthracene	Total Organic Carbon
Di-n-octyl phthalate	Grain Size[a]
Fluoranthene	Total Solids
Indeno(1,2,3-cd)pyrene	
N-Nitrosodiphenylamine	
Phenanthrene	
Phenol	
Total HPAH	

Source: Integral. 2006. Lower Duwamish Waterway Slip 4 Early Action Area: Engineering Evaluation / Cost Analysis.

Notes:

PCB = polychlorinated biphenyl

HPAH = high molecular weight polycyclic aromatic hydrocarbon

[a] Only the slope cap and waterway cap samples were tested for these analytes. Boundary area samples were not evaluated for these analytes.

Table 2-1. Station Coordinates for Slip 4 EAA Visual Monitoring

Photo Station ID	Target Coordinates Northing [a]	Target Coordinates Easting [a]	Orientation (Degrees from True North)	Photo ID	Photo Target Area Description
Existing Stations					
A	199125[c]	1273323[c]	55[b]	A 1	East-Central Sediment Cap
B	199292	1273396	48	B 1	North Sediment Cap
C	199499	1273484	178	C 1	Northwest Slope Cap, South Sediment Cap
			217	C 2	Northwest Slope Cap
D	199432	1273403	24	D 1	Northwest Beach/Anchored Logs
E	199486	1273441	102	E 1	North Slope Cap, Outfalls
			144	E 2	Northeast Slope Cap, North Rip Rap Slough
F	199335	1273415	133	F 1	East Slope Cap, East Sediment Cap, Central Rip Rap Slough
			160	F 2	Southeast Slope and Sediment Cap
G	199355	1273491	200	G 1	South Rip Rap Slough
			27	G 2	North Rip Rap Slough, Sediment Cap, North Slope Cap
			0-360	G 3 [d]	Entire Slip 4 EAA
Supplemental Stations					
H	199378	1273570	306	H 1	Northwest Slope Cap, Beach Cap, Sediment Cap
I	199174[c]	1273581[c]	278	I 1	West Sediment Cap
J	199002[c]	1273268[c]	130[b]	J 1	Southeast Slope Cap

Notes:

EAA = Early Action Area

[a] Washington state plane coordinate system, north zone (NAD-83/91), U.S. feet.

[b] The orientation of these photos is assumed based on the view shown in the baseline photos. The proximity of the 8th Avenue Terminals sheetpile wall affected the use of a compass in confirming the orientation of the monitoring event photo.

[c] The target coordinates for photo stations A, I, and J were relocated in the field. Stations A and J were relocated to provide for on-foot access, and station I was moved slightly west of the target to be within the boundary of the EAA. The new locations were marked with rebar stakes and marking paint.

[d] The 12 individual photos make up the 360° view of the Slip 4 EAA.

Table 2-2. Visual Inspection Summary

Area Observed	Photo Station ID[a]	Date	Time	Azimuth	Area Substrate Classification	Color	Estimate Thickness of Fines	Organic Matter	Wildlife Use Observations	Assessment of Cap Integrity
East-Central Sediment Cap	A1	7/22/2013	1115	55[b] T	Cobble, gravel, sand, silt/clay	Brown	< 1 cm	Trace sticks, fibrous algae, trace leaf litter	Crows feeding on East Sediment Cap, flies	Good
North Sediment Cap	B1	7/22/2013	1103	48 T	Cobble, gravel, sand, silt/clay	Brown surface, gray, brown	< 1 cm on North Sediment Cap	Sticks and twigs on sediment cap, trace leaf litter, same on North Slope Cap	Flies on North Sediment Cap, trace feathers on North Slope Cap	Good
Northwest Slope Cap, South Sediment Cap	C1	7/22/2013	0955	178 T	Cobble, gravel, sand, silt/clay	Brown	< 1 cm on North Sediment Cap	Trace leaves, large and small sticks (largest ~ 10 ft long by 0.5 ft diameter on Slope Cap)	None on Slope Cap observed; flies observed on Sediment Cap	Good
Northwest Slope Cap	C2	7/22/2013	1000	217 T	Cobble, gravel, and sand	Brown and gray	< 1 cm	Log and sticks	None	Same as above
Northwest Beach/Anchored Logs	D1	7/22/2013	1025	24 T	Cobble and sand	Brown and gray	None	Sticks, feathers, log, bird droppings	None observed	Good
North Slope Cap, Outfalls	E1	7/22/2013	1015	102 T	See classification for Station B above	See color for Station B above	None	Sticks and twigs on sediment cap, trace leaf litter, same on North Slope Cap	Trace feathers on North Slope Cap, flies.	Good
Northeast Slope Cap, North Rip Rap Slough	E2	7/22/2013	1020	144 T	Cobble, gravel, sand, silt/clay	Brown surface, gray and brown	< 1 cm on rocks, sand deposits several cm thick in slough	Sticks	None observed	Good
East Slope Cap, East Sediment Cap, Central Rip Rap Slough	F1	7/22/2013	1053	133 T	Cobble, gravel, sand, silt/clay, and organic matter	Brown and gray	< 1 cm	Sticks, algae at high water line	None observed	Good
Southeast Slope and Sediment Cap	F2	7/22/2013	1057	160 T	Gravel, sand, silt/clay	Brown	< 1 cm	Algae coating gravels of cap material	Crows feeding	Good
South Rip Rap Slough	G1	7/22/2013	1038	200 T	Cobble, gravel, sand, silt/clay, organic matter and wood/shell fragments	Brown	< 1cm	Twigs, sticks, sea lettuce and leaves	Flies	Good
North Rip Rap Slough, Sediment Cap, North Slope Cap	G2	7/22/2013	1045	27 T	Cobble, gravel, sand, silt/clay, organic matter and wood/shell fragments	Brown	~ 1 cm	Twigs, sticks, sea lettuce, trace leaf litter	None observed	Good
Northwest Slope Cap, Beach Cap, Sediment Cap	H1	7/22/2013	0933	306 T	Cobble, gravel, and sand	Brown and gray	(not noted)	Feathers, goose droppings	(not noted)	Good
West Sediment Cap	I1	7/22/2013	0920	278 T	Cobble and gravel	Brown	0-1 cm, fines and sand deposits ~3 cm thick in some limited areas on slope	Twigs, fine green algae/moss, trace leaf litter, sticks, bird droppings	Great Blue Heron and crows observed. Heron observed hunting along waterline. Crows pecking at sediment, bird droppings, flies. Some areas of sediment fines show burrow openings	Good
Southeast Slope Cap	J1	7/22/2013	1125	130[b] T	Cobble and gravel	Gray	< 1 cm	Algae coats intertidal portion of slope cap	None observed	Good

Table 2-2. Visual Inspection Summary

Area Observed	Photo Station ID[a]	Date	Time	Azimuth	Assessment of the Re-establishment of Intertidal Aquatic Habitat	Evidence of Pollution	Evidence of Debris/Litter/Garbage	Notes
East-Central Sediment Cap	A1	7/22/2013	1115	55[b] T	One amphipod seen in top 0-2 cm at WC-4 (see Table 2-4)	None observed	None observed	Station location moved from target to the 8th Avenue Terminals bulkhead for on-foot access; new location marked with new rebar and red paint.
North Sediment Cap	B1	7/22/2013	1103	48 T	3 mussels attached to gravel at WC-3 (see Table 2-4)	None observed	Trace litter on North Sediment Cap	Photo station marked with new rebar and red paint.
Northwest Slope Cap, South Sediment Cap	C1	7/22/2013	0955	178 T	None observed	None observed	Trace litter on North Sediment Cap	Photo station marked with new rebar and red paint.
Northwest Slope Cap	C2	7/22/2013	1000	217 T	Two worms observed at 4 cm at WC-1, and one worm observed in sample collection hole at WC-2 (see Table 2-4)	None observed	None observed	Same as above.
Northwest Beach/Anchored Logs	D1	7/22/2013	1025	24 T	Not applicable	None observed	Minor litter	Photo station marked with new rebar and red paint.
North Slope Cap, Outfalls	E1	7/22/2013	1015	102 T	None observed	None observed	Some plastic detritus near high water mark	Photo station marked with new rebar and red paint.
Northeast Slope Cap, North Rip Rap Slough	E2	7/22/2013	1020	144 T	None observed	None observed	None observed	Same as above.
East Slope Cap, East Sediment Cap, Central Rip Rap Slough	F1	7/22/2013	1053	133 T	Some small barnacles on gravel	None observed	None observed	Photo station marked with new rebar and red paint.
Southeast Slope and Sediment Cap	F2	7/22/2013	1057	160 T	Some small barnacles on gravel	None observed	None observed	Same as above.
South Rip Rap Slough	G1	7/22/2013	1038	200 T	Barnacles on intertidal rocks in slough; shell fragments and live mussels (three at WC-8 and two at BD-2) (see Table 2-4)	None observed	None observed	Photo station marked with new rebar and red paint.
North Rip Rap Slough, Sediment Cap, North Slope Cap	G2	7/22/2013	1045	27 T	Barnacles on rocks	None observed	Trace plastic debris	Same as above.
Northwest Slope Cap, Beach Cap, Sediment Cap	H1	7/22/2013	0933	306 T	(not noted)	None observed	Minor plastic debris	Photo station marked with new rebar and red paint.
West Sediment Cap	I1	7/22/2013	0920	278 T	Small barnacles on some riprap rocks and gravel	None observed	None observed	Station moved from the upland property to just within the EAA boundary. New location was marked with new rebar and red paint.
Southeast Slope Cap	J1	7/22/2013	1125	130[b] T	No intertidal fauna observed	None observed	None observed	Station location moved from target to the 8th Avenue Terminals bulkhead for on-foot access; new location marked with new rebar and red paint.

Notes:
[a] Photos are presented in the photo log, in Appendix C.
[b] The orientation of these photos is assumed based on the view shown in the baseline photos. The proximity of the 8th Avenue Terminals sheetpile wall affected the use of a compass in confirming the orientation of the monitoring event photo.

Table 2-3. Station Coordinates for Slip 4 EAA Sampling

Station ID[a]	Target Coordinates Northing	Target Coordinates Easting	Actual Coordinates Northing	Actual Coordinates Easting	Cap Thickness and Material Type
Slope Cap Stations					
SC-2-4	199437.24	1273443.05	199437.24	1273443.05	24-23 in. slope cap and habitat mix
SC-2-8	199444.40	1273426.03	199444.40	1273426.03	
SC-2-12	199444.40	1273426.03	199449.10	1273411.69	
SC-2	199443.58[b]	1273426.92[b]	199443.58[b]	1273426.92[b]	
SC-3-4	199380.61	1273544.05	199380.61	1273544.05	
SC-3-8	199378.60	1273555.46	199378.60	1273555.46	
SC-3-12	199381.17	1273565.44	199381.17	1273565.44	
SC-3	199380.13[b]	1273554.99[b]	199380.13[b]	1273554.99[b]	
Waterway Cap Confirmation Stations					
WC-1	199414.43	1273474.09	199414.43	1273474.09	30-54 in. unarmored outfall area cap
WC-2	199399.42	1273499.06	199399.42	1273499.06	30-54 in. armored outfall area cap
WC-3[c]	199251.02	1273403.73	199251.96	1273410.28	30 in. waterway cap
WC-3[c]	199251.02	1273403.73	199258.18	1273411.17	30 in. waterway cap
WC-4	199247.87	1273513.70	199247.87	1273513.70	30-54 in. unarmored outfall area cap
WC-7	199019.44	1273332.04	199030.44	1273325.86	30 in. waterway cap
WC-8	199012.05	1273404.64	199014.04	1273394.03	60 in. waterway cap
Boundary Area Documentation Stations					
BD-2	198871.43	1273256.97	198894.26	1273260.50	NA
BD-7	198792.66	1273252.33	198800.04	1273255.68	NA

Notes:
Horizontal Datum: Washington State Plane Coordinate System, North Zone (NAD-83/91), U.S. Feet
EAA = Early Action Area
NA = not applicable

[a] See Figure 1-3
[b] Station location is estimated based on calculated centroid for composite samples
[c] Two sediment grabs were collected in order to fulfill the necessary volume requirement for requested analyses.

Table 2-4. Year 1 and Baseline Sample Collection Summary

Station	Sample ID	Date	Time	Bottom Depth (m)	Penetration Depth (cm)	Fines Overlying Cap Material	Fines Thickness (cm)	RPD Depth (cm)	Substrate	Color	Odor	Collection Method	Comments and Notes
SC2-4	SD0036 (composite)	1/30/2012	1506	NA	10	No	0	NA	Gravel, sand, silt/clay, and organic matter	drab olive	None	SS spoon	Trace organics - twigs.
SC2-8			1512	NA	10	No	0	NA	Gravel and sand	drab olive	None	SS spoon	
SC2-12			1517	NA	10	No	0	NA	Gravel and sand	drab olive	None	SS spoon	
SC2-4	SD0107 (composite)	7/22/2013	1246	NA	10	No	0	NA	Cobble, gravel, and sand	brown surface, brown	Slight	SS spoon/trowel	Gravel / cobble / coarse sand.
SC2-8			1253	NA	10	No	0	NA	Cobble, gravel, and sand	brown surface	Slight	SS spoon/trowel	Spotty very thin film of silt in areas. Otherwise gravel, some cobble and coarse sand.
SC2-12			1310	NA	10	No	0	NA	Gravel and sand	brown surface, brown	None	SS spoon/trowel	Gravel layer is atop a 25% sand and 75% gravel mixture.
SC3-4	SD0037 (composite)	1/30/2012	1535	NA	10	No	0	NA	Gravel and sand	drab olive	None	SS spoon	
SC3-8			1540	NA	10	No	0	NA	Sand	drab olive	None	SS spoon	
SC3-12			1543	NA	10	No	0	NA	Sand	drab olive	None	SS spoon	
SC3-4	SD0108 (composite)	7/22/2013	1200	NA	10	No	0	NA	Cobble, gravel, sand, and organic matter	gray	Slight	SS spoon/trowel	Top 5 cm is rounded gravel. From 5-10 cm a mixture of coarse sand and gravel. Thin algae mat covering top of substrate.
SC3-8			1222	NA	10	No	0	NA	Gravel, sand, and organic matter	gray	Slight	SS spoon/trowel	Thin film of algae on top of cap material. Coarse sand from 1-10 cm.
SC3-12			1230	NA	10	No	0	NA	Cobble, gravel, sand, organic matter, and wood and shell fragments	gray and brown	Slight	SS spoon/trowel	Slight organic matter, sticks, thin film of algae. Piece of shell fragment.
WC-1	SD0025	1/30/2012	1042	2.5	15	No	0	NA	Gravel and sand	drab olive	None	Hydraulic grab sampler	Trace organics and twigs
WC-1	SD0100	7/22/2013	0935	NA	10	Yes	1	1	Gravel, sand, silt/clay, and organic matter	brown surface, drab olive, black	Slight	SS spoon/trowel	Fine algae on top of substrate. Drab olive fines top, below 1 cm a 1 cm thick layer of black fines. From 2-10 cm a mixture of gravel and sand. Two worms observed at 4 cm.
WC-2	SD0026	1/30/2012	0958	2.4	15	No	0	NA	Gravel and sand	drab olive, grey	None	Hydraulic grab sampler	Light olive grey gravel with 15% coarse sand
WC-2	SD0101[a]	7/22/2013	1025	NA	10	Yes	<1	1	Gravel, sand, and organic matter	brown surface, drab olive, brown	Slight	SS spoon/trowel	Fine algal mat on surface, few sticks. Gravel/cobble with small boulders. One worm observed in sample collection hole.
WC-2	SD0102												
WC-3	SD0027	1/30/2012	1137	4.8	10	No	0	NA	Gravel, sand, trace silt/clay	drab olive	None	Hydraulic grab sampler	Gravel 2" minus, 25% sand, trace silt

Table 2-4. Year 1 and Baseline Sample Collection Summary

Station	Sample ID	Date	Time	Bottom Depth (m)	Penetration Depth (cm)	Fines Overlying Cap Material	Fines Thickness (cm)	RPD Depth (cm)	Substrate	Color	Odor	Collection Method	Comments and Notes
WC-3	SD0103	7/23/2013	0846	2.4	13	Yes	2	<1	Gravel, sand, silt/clay, and wood and shell fragments	brown surface, drab olive	Slight	Hydraulic grab sampler	80% gravel, 20 % sand/silt. 3 mussels attached to gravel. Color: 5Y 4/2.
WC-3[b]			0913	2.1	15	Yes	8	1	Gravel, sand, silt/clay, and organic matter	brown surface, black, drab olive	Slight	Hydraulic grab sampler	Leaf, few small sticks.
WC-4	SD0028	1/30/2012	1223	1.5	10	No	0	NA	Gravel and sand	drab olive	None	Hydraulic grab sampler	Gravel 2" minus, subangular to subround, 5-10% sand
WC-4	SD0104	7/22/2013	1055	NA	10	Yes	5	0.5	Gravel and sand	brown surface	Slight	SS spoon/trowel	Very thin veneer of fines on top of a mixture of gravel and sand. One amphipod seen in top 0-2 cm.
WC-7	SD0032	2/1/2012	1000	4.8	15	Yes	0	NA	Gravel, sand, and silt/clay	drab olive, grey	None	Hydraulic grab sampler	Washed gravel, clean sand, silt - not mixed (3 separate layers - silt over sand over gravel)
WC-7	SD0105	7/23/2013	1103	1.5	20	Yes	5	1	Gravel, sand, and silt/clay	brown surface, drab olive	Slight	Hydraulic grab sampler	Third attempt successful. Layer of fine silt atop gravel/coarse sand.
WC-8	SD0033	2/1/2012	1130	3.5	15	Yes	0	NA	Gravel and sand	drab olive, brown	None	Hydraulic grab sampler	3 separate layers - silt over sand over gravel
WC-8	SD0106	7/23/2013	1010	1.7	16	Yes	2	1	Gravel, sand, silt/clay, and wood and shell fragments	brown surface, drab olive	None	Hydraulic grab sampler	Second attempt successful. Silt layer on top, interspersed with rounded gravel and coarse sand. 30% gravel, 50% sand, 20% silt. Shell fragments. Three live mussels. Color: 5Y 4/2
BD-2	SD0042	2/14/2012	1345	6.7	10	No	0	NA	Gravel and sand	drab olive, gray	None	Hydraulic grab sampler	Olive gray GRAVEL with coarse to medium sand, gravel subround 1.5" minus (10%)
BD-2	SD0109	7/23/2013	1147	1.2	15	Yes	4	0.5	Gravel, sand, silt/clay, and wood and shell fragments	brown surface, drab olive	Slight	Hydraulic grab sampler	Eighth attempt successful. Four cm layer of fines atop rounded gravel and coarse sand. Two live mussels.
BD-7	SD0053	2/14/2012	1310	5.3	10	No	0	NA	Gravel and sand	drab olive, gray	None	Hydraulic grab sampler	Olive gray SAND (50%) and GRAVEL - 2" minus subround
BD-7	SD0110	7/23/2013	1211	1.9	19	Yes	10		Silt/clay	brown surface, drab olive		Hydraulic grab sampler	First attempt successful. A 10 cm layer of silt. At 12 cm and below is gravel.

Notes:

BD = boundary area
cm = centimeters
ID = identification
m = meter
NA = not applicable.
RPD = redox potential discontinuity
SC = Slope Cap
ss = stainless steel
WC = waterway cap

[a] SD0101 is a field split of SD0102.

[b] Two sediment grabs were collected in order to fulfill the necessary volume requirement for requested analyses.

- Slip 4 post-cap baseline sample collection summary

Table 2-5. Slip 4 EAA Institutional Controls

Institutional Control	Objective	Ownership	Mechanism	Status	Monitoring	Enforcement	Responsibility	Termination
Governmental Controls								
Regulated Navigation Area	Protect the integrity of the sediment cap by restricting vessel operations (e.g., anchoring, grounding, spudding)	City of Seattle	Application to U.S. Coast Guard	Approved by Seattle City Council July 8, 2013, signed by Mayor July 16, filed with City Clerk July 17, 2013. Coast Guard approval is pending. Documentation of the publication of the Final Rule regarding the Slip 4 EAA RNA will be provided in an addendum to the ICIR (Integral 2013b).	Violations may be reported to the Captain of the Port, Puget Sound, Seattle, Washington.	Those found in violation may be subject to civil or criminal penalties as provided for in 33 U.S. Code 1232.	U.S. Coast Guard	Indefinite
Proprietary Controls								
Property Purchase	Allow control over all land uses and monitoring	City of Seattle	Fee-Simple Purchase	The City of Seattle acquired the bed of the Slip property on October 12, 2007; the lot line adjustment with First South Properties, LLC was approved by Seattle City Council July 8, 2013, signed by Mayor July 16, and filed with City Clerk July 17, 2013. First South Properties, LLC is currently working to file the lot line adjustment with the King County Recorder. Documentation of the lot line adjustment recording will be provided to EPA in an addendum to the ICIR (Integral 2013b).	Not required.	None	City of Seattle - Seattle Public Utilities	Indefinite
Environmental Covenants	Restrict landowners from activities that might compromise the sediment caps, slope caps, and engineered soil covers	City of Seattle; The Boeing Company	Uniform Environmental Covenants Act	The City Environmental Covenant was approved by City Council July 8, 2013, signed by Mayor July 16, filed with City Clerk July 17. EPA signed and finalized the covenant on September 19; the covenant was filed with the King County Recorder September 24, 2013. The Boeing Environmental Covenant was signed and finalized by EPA on December 11, 2013 and filed with the King County Recorder on December 20, 2013. An addendum to the ICIR (Integral 2013b) regarding the Boeing Environmental Covenant is being prepared by the City.	The City and Boeing Environmental Covenants will be recorded in Ecology's Integrated Site Information System (ISIS) database. Recording of the City's Environmental Covenant in the ISIS Environmental Covenants database was completed on October 10, 2013. Ecology will monitor the covenants by confirming they are filed along with the publicly available property records.	Landowners have a vested interest in enforcing the covenants in order to avoid fines for breaching the covenant.	Although Ecology has an interest in the covenants, the land owners bear responsibility for maintaining them.	
Enforcement and Permit Tools								
Administrative Orders	A government agency exercises authority by mandating a party to take action and/or restrict use	City of Seattle	EPA or Ecology administers directive	A CERCLA Administrative Settlement Agreement and Order on Consent was issued to the City of Seattle and King County on September 28, 2006.	EPA will review long-term monitoring results no less frequently than every five years.	Administrative orders are enforceable in a court of law.	EPA is enforcing the Slip 4 Administrative Settlement Agreement and Order on Consent; The City of Seattle and King County are responsible for implementing all aspects of the removal action.	Although an administrative order may be terminated at the completion of remediation, periodic reviews ensure the institutional controls for the site remain in place.
Informational Devices								
State Registry	A database of sites of concern for public viewing	Washington State Department of Ecology	Ecology Site Register, the Hazardous Sites list, and the ISIS database	The Lower Duwamish Waterway and Slip 4 are listed on the Hazardous Sites list and in the ISIS database. Public notices will be published in the Site Register as needed.	Ecology monitors sites listed on the Hazardous Sites list.	Informational devices are not legally enforceable and primary serve to inform the public.	Ecology maintains the database.	A site is removed from the Site Register upon reaching a No Further Action status.
Notification Signs	Provides on-site notice to vessel operators of the existence of the sediment cap and prohibition of its disturbance	City of Seattle	Signs installed at the mouth of Slip 4 and near the sediment cap boundaries	Installation completed August 19, 2013; CFR number listed on the signs will be completed once the numbers are established, and documentation will be provided to EPA in an addendum to the ICIR (Integral 2013b).	The condition of the signs will be monitored as part of the Long-Term Monitoring and Reporting Plan.		Signs were installed and will be maintained by the City.	The signs will remain on site indefinitely until a change in conditions warrants their removal.
Health Advisories	Information is dispersed notifying the public of health risks associated with consumption of fish	Fish Consumption Advisories issued by the State Department of Health	Signs, pamphlets, website, etc. (translated into regional languages)	In place for Lower Duwamish Waterway Superfund site. Additional Site-wide advisories may be implemented under EPA and/or Ecology Consent Decree (s) pursuant to the LDW Record of Decision.	The Washington State Department of Health will review data periodically to determine if the advisory should remain in place.		Advisories are created by government agencies (i.e., Department of Health).	Advisories can be terminated when monitoring activities indicate they are no longer needed.

Notes:
ICIR = Institutional Controls Implementation Report
EPA= U.S. Environmental Protection Agency
LDW = Lower Duwamish Waterway
ROD = Record of Decision
CFR = Code of Federal Regulations
ISIS = Integrated Site Information System

Table 4-1. Year 1 Monitoring Field Quality Control Sample Results

		Sample ID:	WC3-FW		WC-2	WC-2split	Relative
		Lab ID:	FW0900		SD0102	SD0101	Percent
		Sample Date:	7/23/2013		7/22/2013	7/22/2013	Difference
Chemical Name	Method	Unit					
PCB Aroclors							
Aroclor 1016	SW8082	µg/kg	0.02 *U*	µg/filter	3.9 *U*	3.9 *U*	--
Aroclor 1221	SW8082	µg/kg	0.02 *U*	µg/filter	3.9 *U*	3.9 *U*	--
Aroclor 1232	SW8082	µg/kg	0.02 *U*	µg/filter	3.9 *U*	3.9 *U*	--
Aroclor 1242	SW8082	µg/kg	0.02 *U*	µg/filter	3.9 *U*	3.9 *U*	--
Aroclor 1248	SW8082	µg/kg	0.02 *U*	µg/filter	39 *U*	29 *U*	--
Aroclor 1254	SW8082	µg/kg	0.02 *U*	µg/filter	68	60	*13*
Aroclor 1260	SW8082	µg/kg	0.02 *U*	µg/filter	33	21	*44*
Total Aroclors	Calculated	µg/kg	0.02 *U*	µg/filter	101	81	*22*
Metals							
Arsenic	SW6010B	mg/kg	2 *U*	µg/filter	6 *U*	7 *U*	*15*
Cadmium	SW6010B	mg/kg	0.1 *U*	µg/filter	0.4	0.4	*0*
Chromium	SW6010B	mg/kg	0.2 *U*	µg/filter	24.5	21.8	*12*
Copper	SW6010B	mg/kg	1	µg/filter	26	28.5	*9.2*
Lead	SW6010B	mg/kg	1 *U*	µg/filter	7	9	*25*
Mercury	SW7471	mg/kg	0.005 *U*	µg/filter	0.03	0.03	*0*
Silver	SW6010B	mg/kg	0.2 *U*	µg/filter	0.4 *U*	0.4 *U*	--
Zinc	SW6010B	mg/kg	5.1	µg/filter	61	67	*9.4*
SVOCs							
Benzo(a)anthracene	SW8270D	µg/kg	0.5 U	µg/filter	94	96	*2.1*
Benzo(a)pyrene	SW8270D	µg/kg	0.5 U	µg/filter	89	96	*7.6*
Benzo(g,h,i)perylene	SW8270D	µg/kg	0.5 U	µg/filter	81	56	*36*
Benzofluoranthenes	SW8270D	µg/kg	0.5 U	µg/filter	230	250	*8.3*
Chrysene	SW8270D	µg/kg	0.5 U	µg/filter	150	160	*6.5*
Dibenzo(a,h)anthracene	SW8270D	µg/kg	0.5 U	µg/filter	23	19	*19*

Table 4-1. Year 1 Monitoring Field Quality Control Sample Results

		Sample ID:	WC3-FW		WC-2	WC-2split	Relative
		Lab ID:	FW0900		SD0102	SD0101	Percent
		Sample Date:	7/23/2013		7/22/2013	7/22/2013	Difference
Chemical Name	Method	Unit					
Fluoranthene	SW8270D	µg/kg	0.5 U	µg/filter	300	320	*6.5*
Indeno(1,2,3-cd)pyrene	SW8270D	µg/kg	0.5 U	µg/filter	65	49	*28*
Pyrene	SW8270D	µg/kg	0.5 U	µg/filter	210	220	*4.7*
HPAH	CALC	µg/kg	0.5 U	µg/filter	1242	1266	*1.9*
Benzoic acid	SW8270D	µg/kg	5 U	µg/filter	65 *J*	190 *U*	--
Benzyl alcohol	SW8270D	µg/kg	2.5 U	µg/filter	19 *U*	19 *U*	--
Bis(2-ethylhexyl) phthalate	SW8270D	µg/kg	0.3 J	µg/filter	470	370	*24*
Butylbenzyl phthalate	SW8270D	µg/kg	0.5 U	µg/filter	42 *U*	19 *U*	--
Di-n-octyl phthalate	SW8270D	µg/kg	0.5 U	µg/filter	52	110	***72***
N-Nitrosodiphenylamine	SW8270D	µg/kg	0.5 U	µg/filter	19 *U*	19 *U*	--
Phenanthrene	SW8270D	µg/kg	0.5 U	µg/filter	58	70	*19*
Phenol	SW8270D	µg/kg	0.5 U	µg/filter	250	160	*44*

Notes:

-- = No calculation performed because one or more of the sample results were not detected.

J = The associated numerical value is the approximate concentration.

U = Not detected above the reported sample quantitation limit.

[box] Exceeds relative percent difference control limit of 50.

Table 5-1. Validated Analytical Results for Slip 4 Cap Samples (0 to 10 cm) - Confirmation (2012) versus Year 1 (2013) Monitoring

				Sample ID:	SC-2	SC-2	SC-3	SC-3	WC-1	WC-1	WC-2	WC-2
				Lab ID:	SD0036	SD0107	SD0037	SD0108	SD0025	SD0100	SD0026	SD0102
				Sample Date:	1/30/2012	7/22/2013	1/30/2012	7/22/2013	1/30/2012	7/22/2013	1/30/2012	7/22/2013
				Source:	RACR	Year 1 LTM	RACR	Year 1 LTM	RACR	Year 1 LTM	RACR	Year 1 LTM
Chemical Name	Method	Unit	SQS	CSL								
PCB Aroclors												
Aroclor 1016	SW8082	µg/kg			3.7 *U*	3.9 *U*	3.8 *U*	3.8 *U*	3.8 *U*	3.8 *U*	19 *U*	3.9 *U*
Aroclor 1221	SW8082	µg/kg			3.7 *U*	3.9 *U*	3.8 *U*	3.8 *U*	3.8 *U*	3.8 *U*	19 *U*	3.9 *U*
Aroclor 1232	SW8082	µg/kg			3.7 *U*	3.9 *U*	3.8 *U*	3.8 *U*	3.8 *U*	3.8 *U*	19 *U*	3.9 *U*
Aroclor 1242	SW8082	µg/kg			3.7 *U*	3.9 *U*	3.8 *U*	3.8 *U*	3.8 *U*	3.8 *U*	19 *U*	3.9 *U*
Aroclor 1248	SW8082	µg/kg			3.7 *U*	5.8 *U*	3.8 *U*	3.8 *U*	3.8 *U*	38 *U*	19 *U*	39 *U*
Aroclor 1254	SW8082	µg/kg			5.7	11	3.8 *U*	6.0	5.5	57	24	68
Aroclor 1260	SW8082	µg/kg			3.7 *U*	6.8	3.8 *U*	3.8 *U*	3.8 *U*	32	19 *U*	33
Total Aroclors	Calculated	µg/kg	130	1300 [a]	5.7	18	3.8 *U*	6.0	5.5	89	24	101
Total Aroclors OC	Calculated	mg/kg-oc	12	65	--	0.96	--	0.46	--	2.4	--	4.8
Conventionals												
Total organic carbon	Plumb1981	percent			0.336	1.86 *J*	0.147	1.31 *J*	0.242	3.76 *J*	0.421	2.11 *J*
Total solids	SM2540G	percent			94	91.1	95	94	91.1	72.8	87.4	76.2
Grain size	PSEP	percent										
Gravel	PSEP	percent			--	54	--	46.1	--	51.2	--	18.3
Very coarse sand	PSEP	percent			--	18.5	--	16.6	--	16.8	--	27.1
Coarse sand	PSEP	percent			--	14.8	--	16	--	12.2	--	24.6
Medium sand	PSEP	percent			--	6.7	--	14.2	--	5.1	--	11.9
Fine sand	PSEP	percent			--	1.5	--	5	--	1.9	--	4
Very fine sand	PSEP	percent			--	0.6	--	0.8	--	1.7	--	1.7
Coarse silt	PSEP	percent			--	0.8	--	1.2 *U*	--	0.8	--	2.5
Medium silt	PSEP	percent			--	0.5	--	1.2 *U*	--	3.1	--	3.1
Fine silt	PSEP	percent			--	0.7	--	1.2 *U*	--	2.6	--	2.4
Very fine silt	PSEP	percent			--	0.7	--	1.2 *U*	--	1.7	--	1.4
Clay, Phi size 8 to 9	PSEP	percent			--	0.5	--	1.2 *U*	--	1	--	1
Clay, Phi size 9 to 10	PSEP	percent			--	0.3	--	1.2 *U*	--	0.9	--	0.8
Clay, Phi size > 10	PSEP	percent			--	0.3	--	1.2 *U*	--	1.1	--	1.3
Total fines	PSEP	percent			--	3.9	--	1.2	--	11.1	--	12.4
Metals												
Arsenic	SW6010B	mg/kg	57	93	5 *U*	5 *U*	5 *U*	5 *U*	5 *U*	7 *U*	5 *U*	6 *U*
Cadmium	SW6010B	mg/kg	5.1	6.7	0.2	0.3	0.2	0.3	0.2	0.5	0.2	0.4
Chromium	SW6010B	mg/kg	260	270	22.3	24	18.1	23.3	16.1	24.9	18.1	24.5
Copper	SW6010B	mg/kg	390	390	16.8	35.6	15	16.5	15.4	43.0	16.6	26
Lead	SW6010B	mg/kg	450	530	3	5	2 *U*	3	2	21	3	7
Mercury	SW7471	mg/kg	0.41	0.59	0.02 *U*	0.02 *U*	0.02 *U*	0.02	0.02 *U*	0.05	0.03 *U*	0.03
Silver	SW6010B	mg/kg	6.1	6.1	0.3 *U*	0.3 *U*	0.3 *U*	0.3 *U*	0.3 *U*	0.4 *U*	0.3 *U*	0.4 *U*
Zinc	SW6010B	mg/kg	410	960	36	62	30	41	31	132	34	61
SVOCs												
Benzo(a)anthracene	SW8270D	µg/kg	110 mg/kg-oc / 1300 µg/kg	270 mg/kg-oc / 1600 µg/kg	20	16 *J*	18 *U*	19 *U*	18 *U*	110	28	94
Benzo(a)pyrene	SW8270D	µg/kg	99 mg/kg-oc / 1600 µg/kg	210 mg/kg-oc / 1600 µg/kg	11 *J*	25	18 *U*	19 *U*	18 *U*	150	20	89
Benzo(g,h,i)perylene	SW8270D	µg/kg	31 mg/kg-oc / 670 µg/kg	78 mg/kg-oc / 720 µg/kg	19 *U*	23	18 *U*	19 *U*	18 *U*	180	14 *J*	81

Table 5-1. Validated Analytical Results for Slip 4 Cap Samples (0 to 10 cm) - Confirmation (2012) versus Year 1 (2013) Monitoring

				Sample ID:	SC-2	SC-2	SC-3	SC-3	WC-1	WC-1	WC-2	WC-2
				Lab ID:	SD0036	SD0107	SD0037	SD0108	SD0025	SD0100	SD0026	SD0102
				Sample Date:	1/30/2012	7/22/2013	1/30/2012	7/22/2013	1/30/2012	7/22/2013	1/30/2012	7/22/2013
				Source:	RACR	Year 1 LTM	RACR	Year 1 LTM	RACR	Year 1 LTM	RACR	Year 1 LTM
Chemical Name	Method	Unit	SQS	CSL								
Benzofluoranthenes	SW8270D	µg/kg	230 mg/kg-oc / 3200 µg/kg	450 mg/kg-oc / 3600 µg/kg	28	72	18 *U*	29 *J*	11 *J*	410	49	230
Chrysene	SW8270D	µg/kg	110 mg/kg-oc / 1400 µg/kg	460 mg/kg-oc / 2800 µg/kg	26	36	18 *U*	14 *J*	10 *J*	240	41	150
Dibenzo(a,h)anthracene	SW8270D	µg/kg	12 mg/kg-oc / 230 µg/kg	33 mg/kg-oc / 230 µg/kg	19 *U*	20 *U*	18 *U*	19 *U*	18 *U*	35	19 *U*	23
Fluoranthene	SW8270D	µg/kg	160 mg/kg-oc / 1700 µg/kg	1200 mg/kg-oc / 2500 µg/kg	53	40	18 *U*	16 *J*	19	300	67	300
Indeno(1,2,3-cd)pyrene	SW8270D	µg/kg	34 mg/kg-oc / 600 µg/kg	88 mg/kg-oc / 690 µg/kg	19 *U*	18 *J*	18 *U*	19 *U*	18 *U*	140	10 *J*	65
Pyrene	SW8270D	µg/kg	1000 mg/kg-oc / 2600 µg/kg	1400 mg/kg-oc / 3300 µg/kg	41	41	18 *U*	16 *J*	12 *J*	300	34	210
HPAH	CALC	µg/kg	960 mg/kg-oc / 12000 µg/kg	5300 mg/kg-oc / 17000 µg/kg	179 *J*	271 *J*	18 *U*	75 *J*	52 *J*	1865	263 *J*	1242
Benzoic acid	SW8270D	µg/kg	650	650	370 *UJ*	200 *U*	360 *UJ*	190 *U*	370 *UJ*	300	380 *UJ*	65 *J*
Benzyl alcohol	SW8270D	µg/kg	57	73	19 *U*	20 *U*	18 *U*	19 *U*	18 *U*	37	19 *U*	19 *U*
Bis(2-ethylhexyl) phthalate	SW8270D	µg/kg	47 mg/kg-oc / 1300 µg/kg	78 mg/kg-oc / 3100 µg/kg	100 *U*	120	22 *U*	48 *U*	68 *U*	**1800**	120 *U*	470
Butylbenzyl phthalate	SW8270D	µg/kg	4.9 mg/kg-oc / 63 µg/kg	64 mg/kg-oc / 900 µg/kg	19 *U*	20 *U*	18 *U*	19 *U*	18 *U*	73	19 *U*	42 *U*
Di-n-octyl phthalate	SW8270D	µg/kg	58 mg/kg-oc / 6200 µg/kg	4500 mg/kg-oc / 6200 µg/kg	19	20 *U*	18 *U*	19 *U*	13 *J*	240	30	52
N-Nitrosodiphenylamine	SW8270D	µg/kg	11 mg/kg-oc / 28 µg/kg	11 mg/kg-oc / 40 µg/kg	19 *U*	20 *U*	18 *U*	19 *U*	18 *U*	19 *U*	19 *U*	19 *U*
Phenanthrene	SW8270D	µg/kg	100 mg/kg-oc / 1500 µg/kg	480 mg/kg-oc / 1500 µg/kg	12 *J*	24	18 *U*	19 *U*	18 *U*	150	12 *J*	58
Phenol	SW8270D	µg/kg	420	1200	19 *U*	20 *U*	18 *U*	19 *U*	18 *U*	92	19 *U*	250

Table 5-1. Validated Analytical Results for Slip 4 Cap Samples (0 to 10 cm) - Confirmation (2012)

				Sample ID:	WC-3	WC-3	WC-4	WC-4	WC-7	WC-7	WC-8	WC-8
				Lab ID:	SD0027	SD0103	SD0028	SD0104	SD0032	SD0105	SD0033	SD0106
				Sample Date:	1/30/2012	7/23/2013	1/30/2012	7/22/2013	2/1/2012	7/23/2013	2/1/2012	7/23/2013
				Source:	RACR	Year 1 LTM	RACR	Year 1 LTM	RACR	Year 1 LTM	RACR	Year 1 LTM
Chemical Name	Method	Unit	SQS	CSL								
PCB Aroclors												
Aroclor 1016	SW8082	µg/kg			20 *U*	4.0 *U*	3.8 *U*	3.8 *U*	3.8 *U*	3.9 *U*	3.7 *U*	*3.9 U*
Aroclor 1221	SW8082	µg/kg			20 *U*	4.0 *U*	3.8 *U*	3.8 *U*	3.8 *U*	3.9 *U*	3.7 *U*	*3.9 U*
Aroclor 1232	SW8082	µg/kg			20 *U*	4.0 *U*	3.8 *U*	3.8 *U*	3.8 *U*	3.9 *U*	3.7 *U*	*3.9 U*
Aroclor 1242	SW8082	µg/kg			20 *U*	4.0 *U*	3.8 *U*	3.8 *U*	3.8 *U*	3.9 *U*	3.7 *U*	*3.9 U*
Aroclor 1248	SW8082	µg/kg			20 *U*	190	3.8 *U*	19 *U*	7.5 *U*	71	3.7 *U*	31
Aroclor 1254	SW8082	µg/kg			21	180	3.8	24	15	110	3.7 *U*	24
Aroclor 1260	SW8082	µg/kg			20 *U*	120	3.8 *U*	15	5.2	70	3.7 *U*	13
Total Aroclors	Calculated	µg/kg	130	1300 [a]	21	490	3.8	39	20.2	251	3.7 *U*	68
Total Aroclors OC	Calculated	mg/kg-oc	12	65	--	**12.3**	--	2.0	--	8.0	--	3.0
Conventionals												
Total organic carbon	Plumb1981	percent			0.270	3.97 *J*	0.111	1.94 *J*	0.341	3.15 *J*	0.057	2.27 *J*
Total solids	SM2540G	percent			87.9	31.8	89.4	83.8	84.7	43.3	94.4	76.9
Grain size	PSEP	percent										
Gravel	PSEP	percent			--	1.3	--	48.8	--	52.7	--	57
Very coarse sand	PSEP	percent			--	1.5	--	17.7	--	4.4	--	17.4
Coarse sand	PSEP	percent			--	1.3	--	14.2	--	4.3	--	12.2
Medium sand	PSEP	percent			--	1.6	--	7.7	--	3.4	--	5.3
Fine sand	PSEP	percent			--	1.4	--	2.3	--	1.4	--	1.2
Very fine sand	PSEP	percent			--	2.5	--	1.3	--	1.1	--	0.5
Coarse silt	PSEP	percent			--	9.9	--	0.5	--	4	--	0.2
Medium silt	PSEP	percent			--	58.2	--	2.1	--	8.1	--	1.7
Fine silt	PSEP	percent			--	7.7	--	2	--	8.5	--	1.6
Very fine silt	PSEP	percent			--	3.3	--	1.4	--	5.2	--	1.1
Clay, Phi size 8 to 9	PSEP	percent			--	1.9	--	0.7	--	2.4	--	0.6
Clay, Phi size 9 to 10	PSEP	percent			--	1.8	--	0.6	--	1.8	--	0.5
Clay, Phi size > 10	PSEP	percent			--	7.7	--	0.7	--	2.9	--	0.8
Total fines	PSEP	percent			--	90.4	--	7.9	--	32.8	--	6.5
Metals												
Arsenic	SW6010B	mg/kg	57	93	5 *U*	20 *U*	5 *U*	6 *U*	6 *U*	10 *U*	5 *U*	6 *U*
Cadmium	SW6010B	mg/kg	5.1	6.7	0.2 *U*	0.9	0.2	0.3	0.2 *U*	0.6	0.2 *U*	0.3
Chromium	SW6010B	mg/kg	260	270	15.5	35	18.8	21.5	16.1	30	16.3	17.2
Copper	SW6010B	mg/kg	390	390	17	71.2	17.3	20.3	16.9	52.4	14.7	20.6
Lead	SW6010B	mg/kg	450	530	3	31	3	4	3	20	2 *U*	5
Mercury	SW7471	mg/kg	0.41	0.59	0.02 *U*	0.16	0.02 *U*	0.02 *U*	0.02 *U*	0.1	0.02 *U*	0.04
Silver	SW6010B	mg/kg	6.1	6.1	0.3 *U*	0.9 *U*	0.3 *U*	0.3 *U*	0.3 *U*	0.6 *U*	0.3 *U*	0.4 *U*
Zinc	SW6010B	mg/kg	410	960	31	164	37	45	36	137	28	41
SVOCs												
Benzo(a)anthracene	SW8270D	µg/kg	110 mg/kg-oc / 1300 µg/kg	270 mg/kg-oc / 1600 µg/kg	20	180	19 *U*	23	28	140	19 *U*	14 *J*
Benzo(a)pyrene	SW8270D	µg/kg	99 mg/kg-oc / 1600 µg/kg	210 mg/kg-oc / 1600 µg/kg	12 *J*	230	19 *U*	38	14 *J*	150	19 *U*	16 *J*
Benzo(g,h,i)perylene	SW8270D	µg/kg	31 mg/kg-oc / 670 µg/kg	78 mg/kg-oc / 720 µg/kg	20 *U*	170 *J*	19 *U*	29	19 *U*	83	19 *U*	19 *U*

Table 5-1. Validated Analytical Results for Slip 4 Cap Samples (0 to 10 cm) - Confirmation (2012)

				Sample ID:	WC-3	WC-3	WC-4	WC-4	WC-7	WC-7	WC-8	WC-8
				Lab ID:	SD0027	SD0103	SD0028	SD0104	SD0032	SD0105	SD0033	SD0106
				Sample Date:	1/30/2012	7/23/2013	1/30/2012	7/22/2013	2/1/2012	7/23/2013	2/1/2012	7/23/2013
				Source:	RACR	Year 1 LTM	RACR	Year 1 LTM	RACR	Year 1 LTM	RACR	Year 1 LTM
Chemical Name	Method	Unit	SQS	CSL								
Benzofluoranthenes	SW8270D	µg/kg	230 mg/kg-oc / 3200 µg/kg	450 mg/kg-oc / 3600 µg/kg	30	660	19 *U*	95	34	440	19 *U*	45
Chrysene	SW8270D	µg/kg	110 mg/kg-oc / 1400 µg/kg	460 mg/kg-oc / 2800 µg/kg	27	380	19 *U*	45	33	240	19 *U*	25
Dibenzo(a,h)anthracene	SW8270D	µg/kg	12 mg/kg-oc / 230 µg/kg	33 mg/kg-oc / 230 µg/kg	20 *U*	37 *J*	19 *U*	19 *U*	19 *U*	22	19 *U*	19 *U*
Fluoranthene	SW8270D	µg/kg	160 mg/kg-oc / 1700 µg/kg	1200 mg/kg-oc / 2500 µg/kg	89	490	20	66	120	390	31 *J*	34
Indeno(1,2,3-cd)pyrene	SW8270D	µg/kg	34 mg/kg-oc / 600 µg/kg	88 mg/kg-oc / 690 µg/kg	20 *U*	140 *J*	19 *U*	27	19 *U*	76	19 *U*	19 *U*
Pyrene	SW8270D	µg/kg	1000 mg/kg-oc / 2600 µg/kg	1400 mg/kg-oc / 3300 µg/kg	55	480	9.3 *J*	59	78	350	19 *J*	31
HPAH	CALC	µg/kg	960 mg/kg-oc / 12000 µg/kg	5300 mg/kg-oc / 17000 µg/kg	233 *J*	2767 *J*	29.3 *J*	382	307 *J*	1891	50 *J*	165 *J*
Benzoic acid	SW8270D	µg/kg	650	650	390 *UJ*	920 *J*	370 *UJ*	190 *U*	370 *UJ*	540	380 *UJ*	190 *U*
Benzyl alcohol	SW8270D	µg/kg	57	73	20 *U*	530	19 *U*	19 *U*	19 *UJ*	390	NA *R*	19 *U*
Bis(2-ethylhexyl) phthalate	SW8270D	µg/kg	47 mg/kg-oc / 1300 µg/kg	78 mg/kg-oc / 3100 µg/kg	61 *U*	1500	31 *U*	99	35	790	24 *U*	51
Butylbenzyl phthalate	SW8270D	µg/kg	4.9 mg/kg-oc / 63 µg/kg	64 mg/kg-oc / 900 µg/kg	20 *U*	55	19 *U*	19 *U*	19 *U*	30	19 *U*	19 *U*
Di-n-octyl phthalate	SW8270D	µg/kg	58 mg/kg-oc / 6200 µg/kg	4500 mg/kg-oc / 6200 µg/kg	12 *J*	160	19 *U*	14 *J*	19 *U*	60	19 *U*	19 *U*
N-Nitrosodiphenylamine	SW8270D	µg/kg	11 mg/kg-oc / 28 µg/kg	11 mg/kg-oc / 40 µg/kg	20 *U*	19 *UJ*	19 *U*	19 *U*	19 *U*	20 *U*	19 *U*	19 *U*
Phenanthrene	SW8270D	µg/kg	100 mg/kg-oc / 1500 µg/kg	480 mg/kg-oc / 1500 µg/kg	33	220	19 *U*	42	43	160	16 *J*	13 *J*
Phenol	SW8270D	µg/kg	420	1200	20 *U*	140	19 *U*	12 *J*	19 *U*	82	19 *U*	37

Notes:

Data Sources: RACR - Lower Duwamish Waterway Slip 4 Early Action Area: Removal Action Completion Report. Integral 2012.

-- = No calculation performed because total organic carbon was outside of range; calculation is not applicable; or analysis was not requested.

CSL = cleanup screening level

J = The associated numerical value is the approximate concentration.

LAET = lowest apparent effect threshold

LTM = long-term monitoring

NA = Not available.

U = Not detected above the reported sample quantitation limit.

UJ = The analyte was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate.

R = Rejected.

RACR = Removal Action Completion Report.

SQS = sediment quality standards

TOC = total organic carbon

Results were OC-normalized for samples with TOC concentrations ranging from 0.5 to 4.0%. Results for samples that had TOC concentrations below or above this range were compared to SQS/CSL values.

Result exceeds LAET/SQS value.

[a] The cleanup screening level is as reported in the Lower Duwamish Waterway feasibility study.

Table 5-2. Validated Analytical Results for Slip 4 Boundary Area Samples - Post-Cap Placement (2012) versus Year 1 (2013) Monitoring

				Sample ID:	BD-2	BD-2	BD-7	BD-7
				Lab ID:	SD0054	SD0109	SD0053	SD0110
				Sample Date:	2/14/2012	7/23/2013	2/14/2012	7/23/2013
				Source:	RACR (post-placement)	Year 1 LTM	RACR (post-placement)	Year 1 LTM
Chemical Name	Method	Unit	SQS	CSL				
PCB Aroclors								
Aroclor 1016	SW8082	µg/kg			3.9 *U*	3.9 *U*	3.8 *U*	3.9 *U*
Aroclor 1221	SW8082	µg/kg			14 *U*	3.9 *U*	3.8 *U*	3.9 *U*
Aroclor 1232	SW8082	µg/kg			3.9 *U*	3.9 *U*	3.8 *U*	3.9 *U*
Aroclor 1242	SW8082	µg/kg			3.9 *U*	3.9 *U*	3.8 *U*	3.9 *U*
Aroclor 1248	SW8082	µg/kg			3.9 *U*	52	3.8 *U*	140
Aroclor 1254	SW8082	µg/kg			3.9 *U*	61	3.8 *U*	150
Aroclor 1260	SW8082	µg/kg			3.9 *U*	41	3.8 *U*	120
Total Aroclors	Calculated	µg/kg	130	1300 [a]	14 *U*	154	3.8 *U*	**410**
Total Aroclors OC	Calculated	mg/kg-oc	12	65	--	4.1	--	--
Conventionals								
Total organic carbon	Plumb 1981	percent			0.162	3.73 *J*	0.073	4.37 *J*
Total solids	SM2540G	percent			89.5	54.4	94.6	35.2

Notes:

Data Sources: RACR - Lower Duwamish Waterway Slip 4 Early Action Area: Removal Action Completion Report. Integral 2012.

-- = No calculation performed because total organic carbon was outside of range; or calculation is not applicable.
J = The associated numerical value is the approximate concentration.
LAET = lowest apparent effect threshold
LTM = long-term monitoring
RACR = Removal Action Completion Report
SQS = sediment quality standards
TOC = total organic carbon
U = Not detected above the reported sample quantitation limit.

Results were OC-normalized for samples with TOC concentrations ranging from 0.5 to 4.0%.
Results for samples that had TOC concentrations below or above this range were compared to SQS/CSL values.

[Boxed] Result exceeds LAET/SQS value.

[a] The cleanup screening level is as reported in the Lower Duwamish Waterway feasibility study.

Table 5-3. Total PCBs and BEHP Concentrations in Subareas of Slip 4

Timing	Area	Total PCBs (µg/kg dw)	BEHP (µg/kg dw)
Pre-Construction			
	Within Slip 4 EAA		
	Data source:	SAIC 2010	SAIC 2010
	min	232	360
	max	8,200	5,000
Post-Construction			
	Within Slip 4 EAA		
	Data source:	Year 1 and AMEC 2013	Year 1
	min	3.7 U	48 U
	max	490	1,800
	Within Boundary Area		
	Data source:	Integral 2012; Year 1; and AMEC 2013	
	min	3.8 U	NA
	max	410	NA
	Between Boundary Area and Mouth of Slip 4		
	Data source:	Integral 2012 and 2013c; Year 1; and AMEC 2013	
	min	133	NA
	max	620	NA
	In LDW near Mouth of Slip 4		
	Data source:	AMEC 2013	
	min	92	NA
	max	233	NA

Notes:
BEHP = bis(2-ethylhexyl) phthalate
dw = dry weight
EAA = Early Action Area
NA = data not available
PCB = polychlorinated biphenyl
U = Not detected above the reported sample quantitation limit.

APPENDIX C

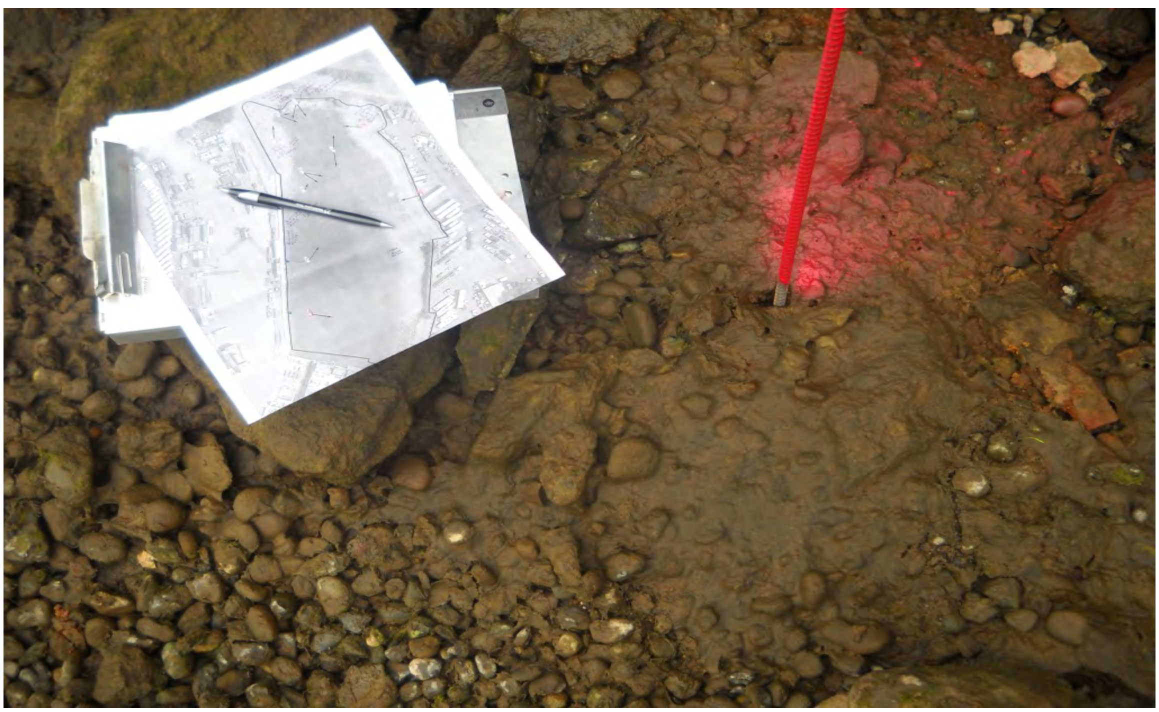
VISUAL INSPECTION PHOTOGRAPHS (2012 AND 2013)

A1_East Central Sediment Cap_2013

A1_East Central Sediment Cap – Azimuth 55 M_2013

A1_East Central Sediment Cap_2012

B1_North Sediment Cap – Azimuth 48 T_2013



B1_North Sediment Cap Fines_2013

C1_Northwest Slope Cap and South Sediment Cap – Azimuth 178 T_2013

C1_Northwest Slope Cap and South Sediment Cap_2012

C2_Northwest Slope Cap - Azimuth 217T_2013

D1_Northwest Beach/Anchored Logs – Azimuth 24 T_2013

D1_Northwest Beach/Anchored Logs_2012

E1_North Slope Cap and Outfalls – Azimuth 102 T_2013

E1_North Slope Cap and Outfalls _2012

E2_Northeast Slope Cap and North Rip Rap Slough – Azimuth 144 T_2013

E2_Northeast Slope Cap and North Rip Rap Slough_2012

F1_East Slope Cap, East Sediment Cap, and Central Rip Rap Slough – Azimuth 133
T_2013

F1_East Slope Cap, East Sediment Cap, and Central Rip Rap Slough_2012

F2_Southeast Slope and Sediment Cap – Azimuth 160 T_2013

F2_Southeast Slope and Sediment Cap –2012

G1_South Rip Rap Slough – Azimuth 200 T_2013

G1_South Rip Rap Slough_2012

G2_North Rip Rap Slough, Sediment Cap, and North Slope Cap – Azimuth 27 T_2013

G2_North Rip Rap Slough, Sediment Cap, and North Slope Cap_2012

G2_North Rip Rap Slough – Sediment Fines_2013

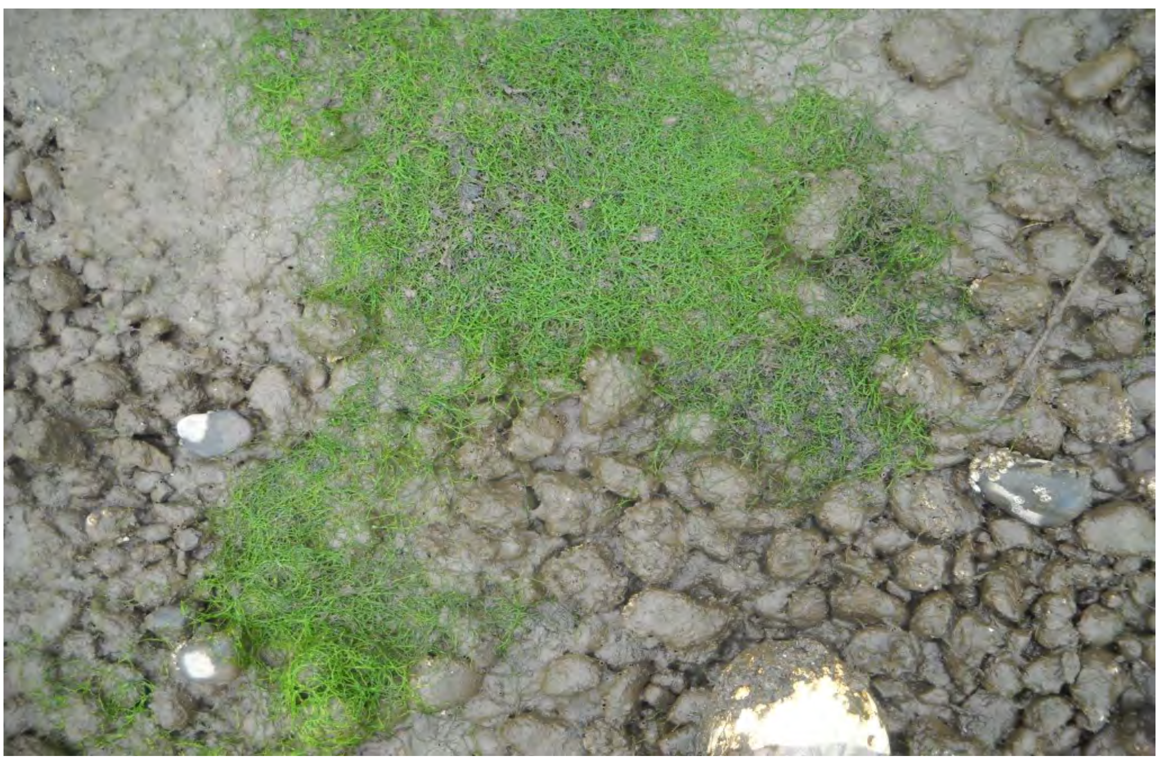
H1_Marker Stake – Azimuth 70 T_2013

H1_Northwest Slope Cap, Beach Cap, and Sediment Cap – Azimuth 306 T_2013

I1_West Sediment Cap_2013_Azimuth 278 T_2013

I1_West Sediment Cap_2013

I1_West Sediment Cap – 2013



I1_West Sediment Cap – Sediment Fines_algae_2013

J1_Southeast Slope Cap – Azimuth 130 T (estimated)_2013

J1_Southeast Slope Cap – Azimuth 130_2013

G3_Entire Slip 4 EAA 1 of 12 – taken in 2013

G3_Entire Slip 4 EAA 2 of 12 – taken in 2013

G3_Entire Slip 4 EAA 3 of 12 – taken in 2013

G3_Entire Slip 4 EAA 4 of 12 – taken in 2013

G3_Entire Slip 4 EAA 5 of 12 – taken in 2013

G3_Entire Slip 4 EAA 6 of 12 – taken in 2013

G3_Entire Slip 4 EAA 7 of 12 – taken in 2013

G3_Entire Slip 4 EAA 8 of 12 – taken in 2013

G3_Entire Slip 4 EAA 9 of 12 – taken in 2013

G3_Entire Slip 4 EAA 10 of 12 – taken in 2013

G3_Entire Slip 4 EAA 11 of 12 – taken in 2013

G3_Entire Slip 4 EAA 12 of 12 – taken in 2013

APPENDIX H

OTHER SEDIMENT INVESTIGATIONS – 8TH AVENUE TERMINALS SEDIMENT SAMPLING

Table 2. Sediment Sample Results

Parameter	SQS	CSL	Station Number:	SG-18	SG-20	SG-21	SG-22	SL4-3	SL4-3split
			Sample Number:	SD0058	SD0059	SD0060	SD0061	SD0062	SD0063
			Sample Date:	10/31/2012	10/31/2012	10/30/2012	10/30/2012	10/31/2012	10/31/2012
			Sample Depth:	0 to 10 cm	0 to 10 cm	0 to 10 cm	0 to 10 cm	0 to 10 cm	0 to 10 cm
PCB Aroclors (mg/kg dry wt)									
Aroclor_1016	--	--		0.019 *U*	0.019 *U*	0.0038 *U*	0.0040 *U*	0.019 *U*	0.020 *U*
Aroclor_1221	--	--		0.019 *U*	0.019 *U*	0.0038 *U*	0.0040 *U*	0.019 *U*	0.020 *U*
Aroclor_1232	--	--		0.019 *U*	0.019 *U*	0.0038 *U*	0.0040 *U*	0.019 *U*	0.020 *U*
Aroclor_1242	--	--		0.019 *U*	0.019 *U*	0.0038 *U*	0.0040 *U*	0.019 *U*	0.020 *U*
Aroclor_1248	--	--		0.150	0.068	0.029	0.038	0.130	0.160
Aroclor_1254	--	--		0.320	0.150	0.064	0.084	0.300	0.370
Aroclor_1260	--	--		0.150	0.098	0.047	0.048	0.110	0.150
Total_Aroclors (calculated)	130	1300[a]		0.620	0.316	0.14	0.17	0.54	0.68
Total Aroclors OC (calculated)[b]	12	65		$\boxed{19}$	8.4	4.2	5.8	$\boxed{17}$	$\boxed{24}$
Conventionals									
Total Organic Carbon (%)	--	--		3.19	3.78	3.35	2.92	3.14 *	2.85
Grain Size (%)	--	--							
Gravel	--	--		0.10 *U*	0.10 *U*	0.10 *U*	0.10 *U*	0.2 *	0.10 *U*
Very Coarse Sand	--	--		2.0	1.6	1.5	2.1	1.4 *	1.8
Coarse Sand	--	--		1.4	1.1	1.0	1.2	1.5 *	1.6
Medium Sand	--	--		0.8	1.1	0.7	1.4	2.6 *	2.7
Fine Sand	--	--		1.0	0.8	1.0	1.3	1.5 *	1.9
Very Fine Sand	--	--		3.2	2.9	4.5	3.9	3.9 *	4.2
Coarse Silt	--	--		7.6	8.5	11.0	9.1	10.6 *	9.5
Medium Silt	--	--		28.3	31.8	26.5	26.6	23.5 *	23.5
Fine Silt	--	--		30.0	29.8	23.9	22.5	22.7 *	23.3
Very Fine Silt	--	--		14.7	13.6	15.4	13.9	14.3 *	14.5
8-9 Phi Clay	--	--		4.9	4.0	5.5	6.0	6.1 *	5.6
9-10 Phi Clay	--	--		2.4	1.9	3.2	4.4	4.2 *	4.2
>10 Phi Clay	--	--		3.6	2.9	5.9	7.5	7.4 *	7.3
Total Fines	--	--		91.5	92.4	91.4	90.0	88.8 *	87.8
Total Solids (%)	--	--		40.5	38.7	40.9	44.7	45.9 *	45.7

Notes:

Bold box outlines indicate value exceeds SQS criteria.

* = Result is the average of laboratory replicate results

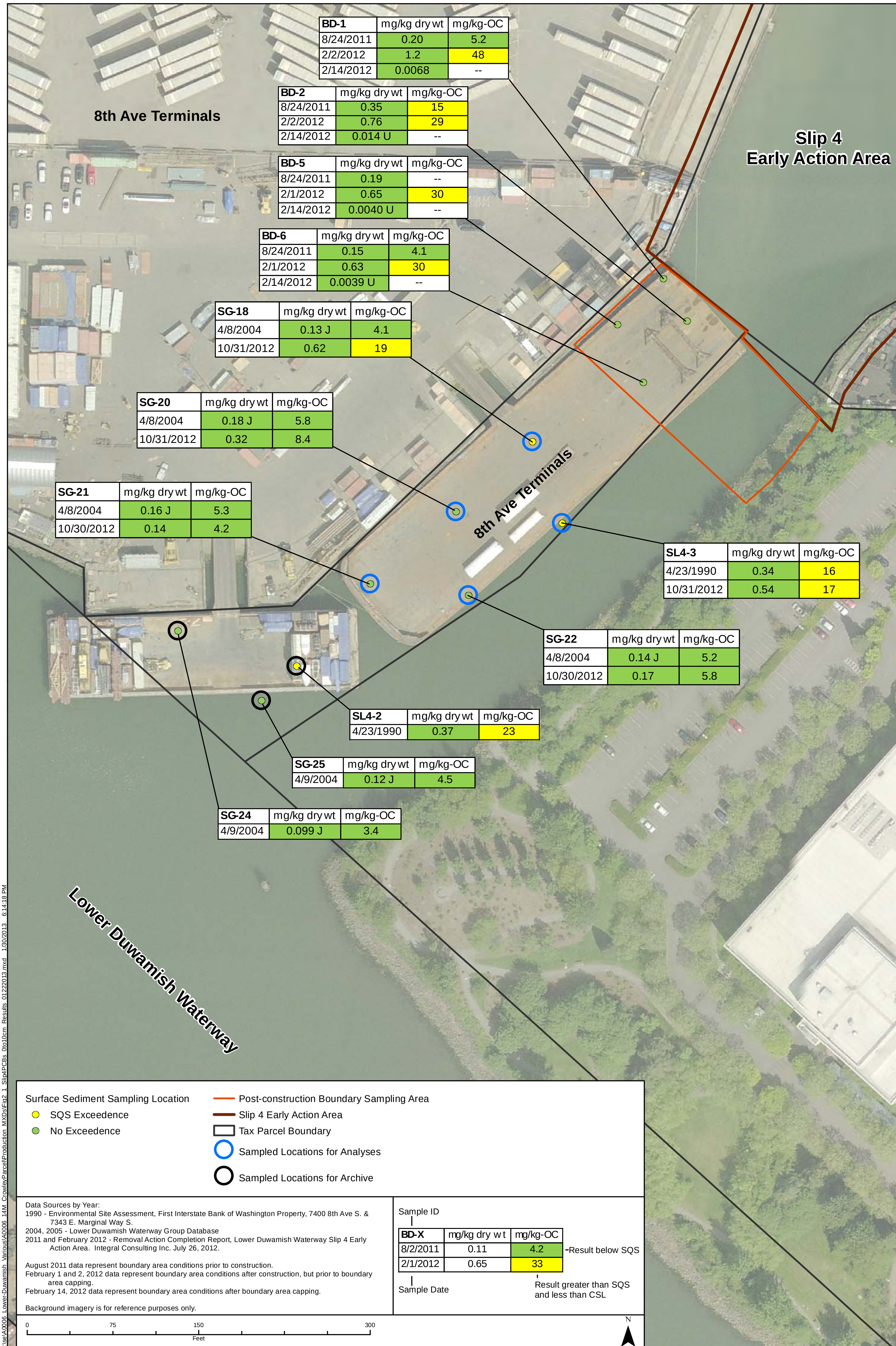
CSL = cleanup screening level

SQS = sediment quality standards

U = Analyte is not detected above the reporting limit shown

[a]The cleanup screening level is as reported in the Lower Duwamish Waterway feasibility study.

[b]Results were OC-normalized for samples with TOC concentrations ranging from 0.5 to 4.0%. Results for samples that had TOC concentrations below or above this range were compared to SQS/CSL values.



integral consulting inc.

Figure 2.
2012 and Historical PCB Concentrations in Surface Sediments (0 - 10 cm) at 8th Avenue Terminals

APPENDIX I

OTHER SEDIMENT INVESTIGATIONS – BOEING PLANT 2 2012–2013 CONSTRUCTION SEASON COMPLETION REPORT

TABLE 9-5

PERIMETER MONITORING SAMPLE RESULTS [1, 2]
2012-2013 Construction Season Completion Report
Duwamish Sediment Other Area and Southwest Bank
Corrective Measure and Habitat Project
Boeing Plant 2
Seattle/Tukwila, Washington

	Sampling Event	Pre-Construction			End—Season 1			Pre-Construction			End—Season 1			Pre-Construction			End—Season 1		
	Location	SD-PER501			SD-PER501			SD-PER502			SD-PER502			SD-PER503			SD-PER503		
	Collection Date	12/21/2012			3/27/2013			12/21/2012			3/27/2013			12/21/2012			3/27/2013		
	Sample Depth (ft)	0 - 0.33			0 - 0.33			0 - 0.33			0 - 0.33			0 - 0.33			0 - 0.33		
	Sample ID	SD-PER501-1212			SD-PER501-0313			SD-PER502-1212			SD-PER502-0313			SD-PER503-1212			SD-PER503-0313		
Analyte	**SMS SQS Criteria [3]**	**Value**	**Q1**	**Q2**	**Value**	**Q1**	**Q2**	**Value**	**Q1**	**Q2**	**Value**	**Q1**	**Q2**	**Value**	**Q1**	**Q2**	**Value**	**Q1**	**Q2**
Conventionals																			
Total Organic Carbon (percent)	—	2.13		J	0.805			1.48		J	1.26			2.73		J	4.14		
Metals (mg/kg)																			
Arsenic	57	7.4			3.2			4.2			4.2			11.5			11.7		
Cadmium	5.1	0.6			0.4			0.4			0.5			0.6			0.9		
Chromium	260	27.2			14.5		J	25.6			17.6			34			29		
Copper	390	41.1			20.9		J	20.9			19.4			43.6			50.6		
Lead	450	17			3			5			4			15			18		
Mercury	0.41	0.06			0.02	U		0.06			0.03			0.11			0.12		
Silver	6.1	0.5	U		0.3	U		0.4	U		0.4	U		0.5	U		0.7	U	
Zinc	410	99			33			45			38			93			98		
PCBs (µg/kg)																			
Aroclor 1016	NE	4.0	U		3.7	U		3.9	U		3.8	U		3.9	U		3.9	U	
Aroclor 1221	NE	4.0	U		3.7	U		3.9	U		3.8	U		3.9	U		3.9	U	
Aroclor 1232	NE	4.0	U		3.7	U		3.9	U		3.8	U		3.9	U		3.9	U	
Aroclor 1242	NE	4.0	U		3.7	U		3.9	U		3.8	U		3.9	U		3.9	U	
Aroclor 1248	NE	30			5.6	Y	UY	13			9.6	Y	UY	26			50		
Aroclor 1254	NE	57			9.9			31			18			54			83		
Aroclor 1260	NE	30			4.6			14			11			36			61		
Total PCBs (µg/kg Dry-Weight)	130	117			14.5			58			29			116			194		
Total PCBs (mg/kg OC) [4]	12	5.5			1.8			3.9			2.3			4.2			—		

	Sampling Event	Pre-Construction			End—Season 1			Pre-Construction			End—Season 1			Pre-Construction			End—Season 1			Pre-Construction			End—Season 1		
	Location	SD-PER504			SD-PER504			SD-PER505			SD-PER505			SD-PER506			SD-PER506			SD-PER507			SD-PER507		
	Collection Date	12/14/2012			3/6/2013			12/13/2012			3/6/2013			12/13/2012			3/7/2013			12/5/2012			3/7/2013		
	Sample Depth (ft)	0 - 0.33			0 - 0.33			0 - 0.33			0 - 0.33			0 - 0.33			0 - 0.33			0 - 0.33			0 - 0.33		
	Sample ID	SD-PER504-1212			SD-PER504-0313			SD-PER505-1212			SD-PER505-0313			SD-PER5061212			SD-PER506-0313			SD-PER507-1212			SD-PER507-0313		
Analyte	**SMS SQS Criteria [3]**	**Value**	**Q1**	**Q2**	**Value**	**Q1**	**Q2**	**Value**	**Q1**	**Q2**	**Value**	**Q1**	**Q2**	**Value**	**Q1**	**Q2**	**Value**	**Q1**	**Q2**	**Value**	**Q1**	**Q2**	**Value**	**Q1**	**Q2**
Conventionals																									
Total Organic Carbon (percent)	—	3.21			3.86			3.05			2.34		J	3.02			3.53			3.35		J	3.56		
Metals (mg/kg)																									
Arsenic	57	15.8			14.7			13			13.1			10.6			10.1			19.3			11.8		
Cadmium	5.1	0.7			1.1			0.7			0.9			0.8			0.9			0.6			0.9		
Chromium	260	35			35			33			30			32			28			31			27		
Copper	390	64.7			68.8			58.4			52.8			54.3			46.7			53.3			42.4		
Lead	450	25			23			25			20			20			18			21			13		
Mercury	0.41	0.19			0.17			0.14			0.12			0.13		J	0.13			0.13			0.17		
Silver	6.1	0.8	U		0.8	U		0.7	U		0.7	U		0.7	U		0.7	U		0.7	U		0.8	U	
Zinc	410	123			122			116			103			110			97			110		J	88		
PCBs (µg/kg)																									
Aroclor 1016	NE	20	U		3.9	U		20	U		3.9	U		3.9	U		4	U		3.8	U		3.9	U	
Aroclor 1221	NE	20	U		3.9	U		20	U		3.9	U		3.9	U		4	U		3.8	U		3.9	U	
Aroclor 1232	NE	20	U		3.9	U		20	U		3.9	U		3.9	U		4	U		3.8	U		3.9	U	
Aroclor 1242	NE	20	U		3.9	U		20	U		3.9	U		3.9	U		4	U		3.8	U		3.9	U	
Aroclor 1248	NE	44			51			99			100		J	32			62			38	Y	UY	64		
Aroclor 1254	NE	110			86			230			160		J	66			100			83			100		
Aroclor 1260	NE	75			64			93			99			35			55			55			59		
Total PCBs (µg/kg Dry-Weight)	130	229			201			422			359			133			217			138			223		
Total PCBs (mg/kg OC) [4]	12	7.1			5.2			13.8			15.3			4.4			6.1			4.1			6.3		

Note(s)
1. Laboratory data flags (Q1) are as follows:
   U = analyte not detected at the reporting limit provided.
   Y = analyte not detected at the reporting limit provided.
   The reporting limit is raised due to chromatographic interferences.
2. Validation qualifiers (Q2) are defined as follows:
   UY = material was not detected; raised reporting limit
   J = analyte positively identified; value is approximate concentration in sample.
3. Criteria obtained from Table 3 of Construction and Post-Construction Sediment Monitoring QAPP (AMEC et al. 2012g).
4. — = no carbon normalized value calculated due to carbon being outside the normal carbon normalization range of 0.5 to 4.0 percent
5. These samples were collected by the City of Seattle and reported analytes were determined by the City.

Abbreviation(s)
ft = feet
mg/kg = milligrams per kilogram
mg/kg OC = milligrams per kilogram organic carbon
PCBs = polychlorinated biphenyls
Q1 = laboratory qualifiers
Q2 = validation qualifiers
QAPP = Quality Assurance Project Plan
RPD = relative percent difference
SMS SQS = Washington Sediment Management Standards Sediment Quality Standards (173-204-320 WAC)
µg/kg = micrograms per kilogram
µg/kg Dry-Weight = micrograms per kilogram dry weight

TABLE 9-5

PERIMETER MONITORING SAMPLE RESULTS [1, 2]
2012-2013 Construction Season Completion Report
Duwamish Sediment Other Area and Southwest Bank
Corrective Measure and Habitat Project
Boeing Plant 2
Seattle/Tukwila, Washington

	Sampling Event	Pre-Construction	End—Season 1	Pre-Construction	End—Season 1	Pre-Construction	End—Season 1	Pre-Construction	Pre-Construction	End—Season 1	Pre-Construction	End—Season 1
	Location	SD-PER508	SD-PER508	SD-PER509	SD-PER509	SD-PER510	SD-PER510	SD-PER511 [6]	SD-PER511 [6]	SD-PER511	SD-PER512	SD-PER512
		City of Seattle Station BD-5 [5]		City of Seattle Station BD-6 [5]		City of Seattle Station SG-18 [5]		City of Seattle Station SL4-3 [5]	City of Seattle Station SL4-3 [5]			
	Collection Date	2/14/2012	3/5/2013	2/14/2012	3/6/2013	10/31/2012	3/5/2013	10/31/2012	10/31/2012	3/6/2013	12/5/2012	3/8/2013
	Sample Depth (ft)	0 - 0.33	0 - 0.33	0 - 0.33	0 - 0.33	0 - 0.33	0 - 0.33	0 - 0.33	0 - 0.33	0 - 0.33	0 - 0.33	0 - 0.33
	Sample ID	SD0052	SD-PER508-0313	SD0051	SD-PER509-0313	SD0058	SD-PER510-0313	SD0062	SD0063	SD-PER511-0313	SD-PER512-1212	SD-PER512-0313
Analyte	**SMS SQS Criteria [3]**	Value Q1 Q2	Value Q1 Q2	Value Q1 Q2	Value Q1 Q2	Value Q1 Q2	Value Q1 Q2	Value Q1 Q2	Value Q1 Q2	Value Q1 Q2	Value Q1 Q2	Value Q1 Q2
Conventionals												
Total Organic Carbon (percent)	—	0.085	3.54	0.171	2.57	3.19	3.85	3.14	3.14	4.55	2.48	2.21
Metals (mg/kg)												
Arsenic	57		15.3		14.9		16			13.2	16	31.7
Cadmium	5.1		1.1		1.1		1.2			1.2	0.4	0.8
Chromium	260		35		34		36			33	29	27.3
Copper	390		69.4		67.8		75.5			61.2	49.1	58.1
Lead	450		24		21		24			23	23	27
Mercury	0.41		0.18		0.16		0.2			0.15	0.1	0.07
Silver	6.1		0.7 U		0.8 U		0.7 U			0.8 U	0.6 U	0.5 U
Zinc	410		128		117		124			120	146	160
PCBs (µg/kg)												
Aroclor 1016	NE	4 U	3.8 U	3.9 U	3.9 U	19 U	3.8 U	19 U	20 U	3.9 U	3.9 U	4 U
Aroclor 1221	NE	4 U	3.8 U	3.9 U	3.9 U	19 U	3.8 U	19 U	20 U	3.9 U	3.9 U	4 U
Aroclor 1232	NE	4 U	3.8 U	3.9 U	3.9 U	19 U	3.8 U	19 U	20 U	3.9 U	3.9 U	4 U
Aroclor 1242	NE	4 U	3.8 U	3.9 U	3.9 U	19 U	3.8 U	19 U	20 U	3.9 U	3.9 U	4 U
Aroclor 1248	NE	4 U	68	3.9 U	63	150	95	130	160	69	19 Y	36
Aroclor 1254	NE	4 U	100	3.9 U	110	320	130	300	370	120	55	63
Aroclor 1260	NE	4 U	73	3.9 U	73	150	84	110	150	78	37	37
Total PCBs (µg/kg Dry-Weight)	130	4 U	241	3.9 U	246	620	309	540	680	267	92	136
Total PCBs (mg/kg OC) [4]	12	—	6.8	—	9.6	19.4	8.0	17.2	21.7	—	3.7	6.2

Note(s)
1. Laboratory data flags (Q1) are as follows:
   U = analyte not detected at the reporting limit provided.
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5. These samples were collected by the City of Seattle and reported analytes were determined by the City.
6. Split sample analyzed at this location

Abbreviation(s)
ft = feet
mg/kg = milligrams per kilogram
mg/kg OC = milligrams per kilogram organic carbon
PCBs = polychlorinated biphenyls
Q1 = laboratory qualifiers
Q2 = validation qualifiers
QAPP = Quality Assurance Project Plan
RPD = relative percent difference
SMS SQS = Washington Sediment Management Standards Sediment Quality Standards (173-204-320 WAC)
µg/kg = micrograms per kilogram
µg/kg Dry-Weight = micrograms per kilogram dry weight

TABLE 9-5

PERIMETER MONITORING SAMPLE RESULTS [1, 2]
2012-2013 Construction Season Completion Report
Duwamish Sediment Other Area and Southwest Bank
Corrective Measure and Habitat Project
Boeing Plant 2
Seattle/Tukwila, Washington

	Sampling Event	Pre-Construction	End—Season 1	Pre-Construction	End—Season 1	Pre-Construction	End—Season 1	Pre-Construction	End—Season 1	Pre-Construction	End—Season 1	Pre-Construction	End—Season 1	Pre-Construction	End—Season 1
	Location	SD-PER513	SD-PER513	SD-PER514	SD-PER514	SD-PER515	SD-PER515	SD-PER516	SD-PER516	SD-PER517	SD-PER517	SD-PER518	SD-PER518	SD-PER525	SD-PER525
		City of Seattle Station SG-20 [5]		City of Seattle Station SG-22 [5]		City of Seattle Station SG-21 [5]		City of Seattle Station SL4-2 [5]		City of Seattle Station SG-25 [5]		City of Seattle Station SG-24 [5]		Field Dup. of SD-PER505	Field Dup. of SD-PER505
	Collection Date	10/31/2012	3/5/2013	10/30/2012	3/6/2013	10/30/2012	3/5/2013		3/7/2013		3/7/2013		3/7/2013	12/13/2012	3/6/2013
	Sample Depth (ft)	0 - 0.33	0 - 0.33	0 - 0.33	0 - 0.33	0 - 0.33	0 - 0.33		0 - 0.33		0 - 0.33		0 - 0.33	0 - 0.33	0 - 0.33
	Sample ID	SD0059	SD-PER513-0313	SD0061	SD-PER514-0313	SD0060	SD-PER515-0313		SD-PER516-0313		SD-PER517-0313		SD-PER518-0313	SD-PER525-1212	SD-PER525-0313
Analyte	**SMS SQS Criteria [3]**	Value Q1 Q2	Value Q1 Q2	Value Q1 Q2	Value Q1 Q2	Value Q1 Q2	Value Q1 Q2	Value Q1 Q2	Value Q1 Q2	Value Q1 Q2	Value Q1 Q2	Value Q1 Q2	Value Q1 Q2	Value Q1 Q2	Value Q1 Q2
Conventionals															
Total Organic Carbon (percent)	—	3.78	3.89	2.92	4.73	3.35	4.07		3.41		6.27		2.34	2.64	3.39 J
Metals (mg/kg)															
Arsenic	57		14.7		11.7		13.1		9.6		11.2		13.9	10.4	13.1
Cadmium	5.1		1.2		1.1		1.1		0.9		0.7		0.9	0.7	1.2
Chromium	260		36		32		34		26		19		30	29	34
Copper	390		73.5		57.8		62.5		46.1		33		58.1	48.2	65
Lead	450		24		21		24		18		14		23	22	26
Mercury	0.41		0.23		0.18		0.17		0.15		0.11		0.15 J	0.08	0.17
Silver	6.1		0.8 U		0.7 U		0.7 U		0.7 U		0.8 U		0.7 U	0.7 U	0.7 U
Zinc	410		120		111		116		94		67		109	101	124
PCBs (µg/kg)															
Aroclor 1016	NE	19 U	3.8 U	40 U	4 U	38 U	3.9 U		3.8 U		4 U		4 U	19 U	3.9 U
Aroclor 1221	NE	19 U	3.8 U	40 U	4 U	38 U	3.9 U		3.8 U		4 U		4 U	19 U	3.9 U
Aroclor 1232	NE	19 U	3.8 U	40 U	4 U	38 U	3.9 U		3.8 U		4 U		4 U	19 U	3.9 U
Aroclor 1242	NE	19 U	3.8 U	40 U	4 U	38 U	3.9 U		3.8 U		4 U		4 U	19 U	3.9 U
Aroclor 1248	NE	68	130	38	81	29	68		60		75		86	99	190 J
Aroclor 1254	NE	150	150	84	130	64	100		100		130		140	200	300 J
Aroclor 1260	NE	98	82	48	97	47	82		53		76		100	86	120
Total PCBs (µg/kg Dry-Weight)	130	316	362	170	308	140	250		213		281		326	385	610
Total PCBs (mg/kg OC) [4]	12	8.4	9.3	5.8	—	4.2	—		6.2		—		13.9	14.6	18.0

Note(s)
1. Laboratory data flags (Q1) are as follows:
   U = analyte not detected at the reporting limit provided.
   Y = analyte not detected at the reporting limit provided.
   The reporting limit is raised due to chromatographic interferences.
2. Validation qualifiers (Q2) are defined as follows:
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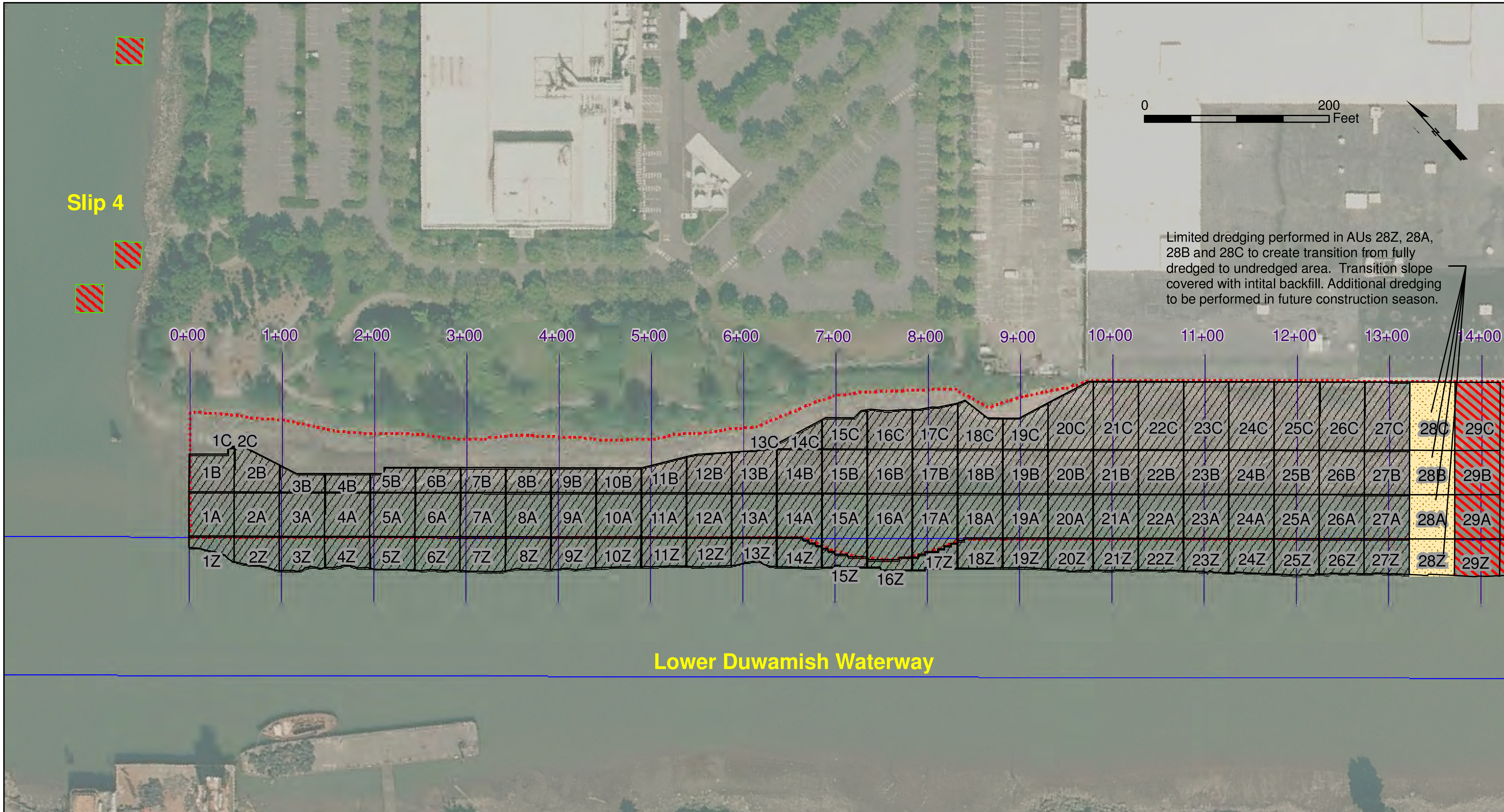
4. — = no carbon normalized value calculated due to carbon being outside the normal carbon normalization range of 0.5 to 4.0 percent
5. These samples were collected by the City of Seattle and reported analytes were determined by the City.
6. Split sample analyzed at this location

Abbreviation(s)
ft = feet
mg/kg = milligrams per kilogram
mg/kg OC = milligrams per kilogram organic carbon
PCBs = polychlorinated biphenyls
Q1 = laboratory qualifiers
Q2 = validation qualifiers
QAPP = Quality Assurance Project Plan
RPD = relative percent difference
SMS SQS = Washington Sediment Management Standards Sediment Quality Standards (173-204-320 WAC)
µg/kg = micrograms per kilogram
µg/kg Dry-Weight = micrograms per kilogram dry weight



Approval Units (AUs)
Undredged
Initial Backfill
Dredged & Intermediate Backfill
3+00 Cross Section Positions
Duwamish Sediment Other Area
Navigation Channel Boundary
Slip 4 Dredge Areas

BOEING

STATUS OF APPROVAL UNITS FOLLOWING
2012-2013 CONSTRUCTION SEASON
2012-2013 Construction Season Completion Report
Duwamish Sediment Other Area and Southwest
Bank Corrective Measure and Habitat Project,
Boeing Plant 2, Seattle/Tukwila, Washington

By: RHG	Date:5/20/2013	Project No. 0131320080
		Figure 3

File path: "P:\BOEING\DESIGN\FIELD DATA\Perimeter Monitoring\Sample Locations041113.mxd"

Legend

- Boeing Limits of Dredging
- Crowley Pier
- Jorgensen Cleanup Area
- Jorgensen Limits of Dredging
- T-117 Cleanup Area
- Slip 4 Cap Area
- Dredged Units
- Initial Backfill
- Perimeter Monitoring Areas
- Boeing Plant 2 Parcel
- Navigation Channel Boundary
- Pre-construction Samples (December 2012)
  SD-PER106/126 (Field Duplicate)
- End of Season 1 (March 2013)
  SD-PER508

Note:
Markers are positioned at average location based on three grab samples for all locations except SD-PER501, SD-PER502, and SD-PER503. Samples collected on Slip 4 cap (SD-PER501, SD-PER502, and SD-PER503) were sampled using hand cores and divers. Symbol placed at approximate sample location.

BOEING

PERIMETER MONITORING SAMPLE LOCATIONS
2012-2013 CONSTRUCTION SEASON
2012-2013 Construction Season Completion Report
Duwamish Sediment Other Area and Southwest Bank Corrective Measure and Habitat Project,
Boeing Plant 2, Seattle/Tukwila, Washington

By: RHG	Date5/7/2013	Project No. 0131320080
		Figure 4